Geotechnical Data Report

SR 395 – North Spokane Corridor
Section 2 – From US 2 to SR 395
Spokane, Washington

March 26, 2001

Prepared for

Washington State Department of Transportation

Prepared by

LANDAU ASSOCIATES, INC.

4210 20th Street E., Suite F • Tacoma, WA 98424 • (253) 926-2493

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1.0 INTRODUCTION

This geotechnical data report summarizes the field investigation and geotechnical laboratory testing completed in support of the Washington State Department of Transportation (WSDOT) SR 395 North Spokane Corridor – Section 2 project. The purpose of this investigation was to obtain subsurface information to characterize soil and groundwater conditions along the proposed Section 2 alignment.

The project location is shown on the Vicinity Map, Figure 1. The Site and Exploration Plan, Figure 2, shows the project area and location of the borings drilled for this investigation. A description of the field exploration program, the boring logs summarizing subsurface conditions, and a table summarizing pertinent information regarding each boring, are included in Appendix A of this data report. A description of the laboratory testing program along with the results of the laboratory testing are included in Appendix B of this data report.

Landau Associates was contracted by the Washington State Department of Transportation to provide geotechnical services to support the project. Our services were provided in accordance with on-call geotechnical services Agreement No. Y-7373 between the Washington State Department of Transportation and Landau Associates, Inc., and Task AB, Work Order XL-1154, and our July 31, 2000 Scope and Estimated Cost letter.

Our scope of services included the following specific tasks:

- Drilled 12 borings to depths of approximately 30 to 100 ft below the existing ground surface to characterize soil and groundwater conditions.
- Installed piezometers in selected borings for subsequent measurement of groundwater levels.
- Completed geotechnical laboratory testing on selected samples obtained from the borings. Laboratory testing consisted of natural moisture content determinations, grain-size analyses, and Atterberg Limit determinations. Laboratory testing was completed by Soil Technology, Inc. under subcontract to Landau Associates.
- Prepared and submitted this data report summarizing the field exploration and laboratory testing program, and regional and project site geology.

2.0 PROJECT DESCRIPTION

As shown on the Vicinity Map, Figure 1, the proposed SR 395 North Spokane Corridor Project is planned to connect Interstate 90 (I-90) with US Highway 2 (US 2) and rejoin State Route 395 (SR 395) at the Little Spokane River. As currently proposed, the corridor will extend north from I-90, west of Freya Street, and parallels Market Street until Francis Avenue. In the vicinity of Francis Avenue, the alignment jogs northeast about ¼ mile, and then continues northward. The proposed alignment crosses at the junction of Market Street and Hawthorne Road, and then turns northwest and intersects US 2 at Shady Slope Road. North of Shady Slope Road, the alignment turns westward and ties into SR 395 just south of the Little Spokane River bridge at SR 395.

The Section 2 project extends from US 2 to SR 395. An elevated crossing is planned at Wandermere Road and at US 2. Interchanges are proposed for US 2 and SR 395. Cuts up to about 60 ft are anticipated west of US 2 to establish road grades, and fills up to about 30 to 35 ft are proposed for the approaches at the Wandermere Road elevated crossing.

3.0 GEOLOGIC SETTING

The following sections provide a description of the existing surface conditions and topographic setting, regional geology of the project area, and a description of the various geologic units encountered in the explorations along with a summary of the distribution of the various geologic units encountered in the project area.

3.1 SURFACE AND TOPOGRAPHIC CONDITIONS

The project area lies within the northern portion of the Spokane Valley, about 2 miles north of the north city limit of Spokane. The surface topography within the Section 2 area varies from gently rolling in the eastern portion of the project to steeply sloping in the vicinity of Wandermere Road. The proposed Section 2 route is predominately undeveloped, and surface vegetation varies from nearly bare ground to sparse grassland and pine forest. The route crosses near a rock quarry at Perry Road and a gravel pit east of Wandermere Road.

Most of the surficial soil observed along the Section 2 route consists of silty sand, poorly-graded sand, and well-graded sand. These soil types are generally considered to have a moderate to severe potential for wind and/or water erosion.

Localized areas of steep slopes (slopes with gradients of 40 percent or more) exist along the Section 2 route. These areas included three, elongated topographic features between US 2 and Garden Road (approximate stations 470+00 to 476+00, 480+00 to 482+00, and 484+00 to 486+00); the toe of a south-facing hillside north of the proposed Section 2 route (station 500+00 to 510+00); a west-facing slope between about station 522+50 to 527+00; and the slopes within the gravel pit east of Wandermere Road and the east-facing slope below SR 395 (approximate station 537+00 to 549+00). With the exception of the slopes in the gravel pit east of Wandermere Road, and the slope along the east side of SR 395, the slopes within the Section 2 area appear to be natural. These slopes are generally vegetated and appear to be relatively stable at this time. Slopes in the gravel pit area east of Wandermere Road and along the east-facing slope along SR 395 are human-made cuts. The slope along the east side of SR 395 is well vegetated and appears to be generally stable at this time. Slopes within the gravel pit appear to be near the soil's natural angle of repose based on the sparseness of vegetation on the slopes and our past experience with similar soil types. These slopes will likely be subject to continued raveling.

3.2 REGIONAL GEOLOGY

Bedrock and sedimentary units in the project area include, from oldest to youngest: metamorphic and igneous rocks, the Latah Formation and Columbia River Basalt Group, Lake Missoula catastrophic flood deposits, and eolian deposits, which are described in the following paragraphs.

3.2.1 PRE-TERTIARY METAMORPHIC AND IGNEOUS ROCKS

The Spokane area is underlain by high-grade metamorphic rocks of the Spokane dome of the Priest River metamorphic core complex. The core rocks have been intruded by Cretaceous and early Tertiary granitic rocks (Boleneus and Derkey 1996). These rocks were deeply eroded, leaving a surface of considerable relief.

These rocks formed a generally northwest-trending mountain range with drainages extending into the lowlands to the south. Limited exposures of the Priest River metamorphic complex have been mapped along the base of the hillside in the vicinity of Lincoln Road and Saint Michael Road (Joseph 1990). Exposures of the granitic rocks have been mapped southeast of the intersection of Market Street and Stoneman Road (Derkey 1997), along the base of the hillside in the vicinity of Fairview Road (Kiver, Rigby, and Stradling 1979), and along the west side of SR 395, south of the Little Spokane River Bridge (Derkey, Gerstel and Logan 1998).

3.2.2 TERTIARY VOLCANIC AND SEDIMENTARY ROCKS

During the Miocene Epoch (late Tertiary), between 5 and 24 million years ago, extensive flows of basaltic lava flooded the region, covering the lower valleys and foothills and abutting the higher mountains. The basalt flows covered more than 100,000 square miles in parts of Washington, Idaho, and Oregon. The basalt flows are generally thought to have entered the Spokane area from the south and southwest, probably erupting from vents in the area of the Chief Joseph dike swarm in the southeast corner of Washington (Robinson 1991). In the project area, the individual flows are generally flat-lying and have thicknesses of 50 to 150 ft (Griggs 1973). Two formations of the Columbia River Basalt Group have been mapped in the area: the Wanapum Basalt (Priest Rapid Member) and the Grande Ronde Basalt (Derkey 1997; Derkey, Gerstel, and Logan 1998). The Grande Ronde Basalt is between 15.6 and 16.4 million years old, and is generally designated as "valley" flows due mainly to exposures in valleys around the Spokane area. The Wanapum Basalt is between 15 and 14 million years old and is generally designated as "rim rock" flows mainly because it caps the bluffs in the project area. The basal contact of the Wanapum Basalt is typically about elevation 2,200 ft in the project area (Derkey 1997).

The earlier basalt flows likely blocked stream/river drainages, possibly including those of the ancestral Spokane and Columbia River, forming either a series of lakes (or possibly a single large basin as argued by Robinson [Robinson 1991] based on stratigraphic correlations) along the north and east rim of the basalt field. The basin is generally thought to be arcuate in shape, extending from near Grand Coulee Washington to Moscow, Idaho. Lacustrine sediments, derived from erosion of the older basalts and the pre-Tertiary rocks in the region, were deposited in the basin. These sediments, consisting of primarily silt and clay, with minor sand and gravel, form the Latah Formation. The Latah Formation is generally described as poorly indurated siltstone, claystone, sandstone, and minor conglomerate, containing scattered volcanic ash layers. Little data is available regarding the general depositional nature of the Latah Formation, but sediment was likely deposited by drainages flowing into the basin from the east and north. The Latah Formation generally exhibits an "upward coarsening" sequence, which is typical of lake-type depositional environments.

The Latah Formation discontinuously outcrops along the north and east rims of the basalt field. Outcrops have been mapped as far west as Grand Coulee and near Kellers Ferry, Washington, and encountered in deep wells at Davenport and Odessa, Washington (Robinson 1991). The Latah Formation is exposed along I-90 in the Coeur d'Alene area (ITD 2000) and is intermittently present as far south as Moscow, Idaho (Robinson 1991).

In the general project area, the Latah Formation is estimated to be more than 1,000 ft thick in places (Derkey 1997). Where exposed in the Spokane region, the Latah Formation generally overlies the Grande Ronde Basalt and underlies the Wanapum Basalt. Within the project area, the Latah Formation is overlain by Wanapum Basalt and is exposed on the hillsides east of Market Street at the south end of Section 1 and the northern end of Section 3, and in limited exposures on the hillsides northwest of US 2.

3.2.3 Pleistocene and Holocene Geology

During the Pleistocene Epoch (early Quaternary), 10,000 to 2 million years ago, vast continental ice sheets advanced into the Spokane valley. Evidence indicates that there were at least four to possibly six advances of the continental ice into the region during the Pleistocene (Molenaar 1988). The latest advance, which occurred between about 12,000 and 22,000 years ago, had the greatest effect on the present day landscape. Two lobes of ice advanced into the area: the Pend Oreille lobe, which is thought to have advanced west down the present day Spokane River Valley to as far as the eastern city limits (Weis and Richmond 1965); and the Little Spokane lobe which is thought to have advanced southward to near Milan (Weis and Richmond 1965), about 15 miles north of the project area. Melt water deposits, chiefly of sand and gravel, with silt and clay, were deposited in and along the valleys of the Little Spokane and Spokane Rivers. In addition, a proglacial lake, known as Lake Columbia, occupied much of

the Spokane Valley during the Pleistocene. Remnants of the lake sediments exist in tributary valleys such as the Peone Prairie north of Spokane (east of the project area). The glacial lake deposits consist predominantly of sand, silt and clay with scattered drop stones.

Glacial ice of the Purcell lobe is thought to have periodically blocked the Clark Fork River near the present day Idaho/Montana border, forming a great ice dam across the valley. Melt water from other ice lobes further up the Clark Fork River drainage became impounded behind the ice dam, forming a vast lake in present day western Montana referred to as Glacial Lake Missoula. At its highest level, the lake covered an estimated 3,000 square miles and contained an estimated 500 cubic miles of water (Molenaar 1988). Periodically the ice dam failed, releasing an enormous volume of water that flowed across the landscape. It has been speculated that the entire lake may have drained within a few days, resulting in a peak flow across the Columbia Plateau at 750 million cubic feet a second (Molenaar 1988). The majority of this flood water rushed through the Spokane River and Little Spokane River valleys en route to the Columbia River.

Flood waters inundated the Spokane area to a maximum elevation of 2,700 ft (Derkey 1997). Though the number of Pleistocene flood events are unknown, each flood event likely swept down the Spokane and Little Spokane River valleys scouring deposits of the previous flood events, cutting new channels into the pre-Pleistocene bedrock, and leaving behind new deposits of boulders, cobbles, gravel, and sand. In less energetic environments, slack water deposits of chiefly sand and lacustrine sediments were laid down. The maximum thickness of the flood deposits in the Little Spokane River Valley are on the order of 500 ft (Derkey 1997).

Surficial deposits of wind-blown sand (Holocene [present to 10,000 years ago] and Pleistocene Epoch) are present over the flood deposits over much of the project area, south of Farwell Road. The wind-blown deposits are derived primarily from Pleistocene flood deposits that mantle much of the project area.

3.3 PROJECT GEOLOGY

Pleistocene flood deposits (Qf) were encountered at the surface in all of the borings, with the exception of PH2-2-00, where basalt (Mv) was encountered at the surface and extended to the depth explored. Where encountered, the Pleistocene flood deposits generally extend to the depths explored in all borings but SSSB-1-00, PH2-1-00, PH2-2-00, PH2-5-00, and WAND-2-00. Bedrock was encountered in these borings beneath the Pleistocene flood deposits. The Pleistocene flood deposits generally consist of loose to very dense, well-graded and poorly-graded, fine to medium and fine to coarse sand, and silty sand. In the sandy zones, the gravel content was variable, ranging from none to with gravel. The sand was typically grayish-brown to brown in color, with subrounded to rounded grains. Reaction to

hydrochloric acid (HCL) was generally strong, but occasionally weak to none. These deposits are consistent with a lower energy environment, such as at the margins of the flood, in back waters, or as the flood waters receded.

In boring PH2-3-00, silty gravel and poorly-graded gravel was encountered between a depth of about 9 to 27 ft. In boring PH2-5-00, a zone of cobbles with clay was encountered between a depth of about 30 and 46 ft. In boring WAND-2-00, gravel with cobbles was encountered between a depth of about 58 and 69 ft. These zones of gravel and cobbles likely represent higher energy deposits laid down during Pleistocene flood events.

In boring SSSB-2-00, stiff lean clay and dense silt were interfingered with the Pleistocene flood deposits between a depth of about 39 to 45.5 ft. In boring WAND-2-00, interbeds of fat clay were observed at depths of about 50, 55, 70 and 90 ft. These units are interpreted to be slack-water deposits laid down during the Pleistocene floods. These deposits are often overlain and underlain by, and occasionally interbedded with, the lower energy flood deposit of well-graded and poorly-graded sand.

Beneath the Pleistocene flood deposits, the Latah Formation was encountered in borings PH2-1-00 and PH2-5-00. At boring PH2-1-00, the Latah Formation was encountered at a depth of about 38 ft and was observed to have the consistency of a very hard, lean clay soil. The deposit was reddish brown, stratified, and contained coarse sand and fine gravel. Below a depth of about 56 ft, the deposit becomes very gravelly with cobbles. The boring appears to have met refusal on basalt bedrock at a depth of about 60 ft. At boring PH2-5-00, the Latah Formation was encountered below a depth of about 46 ft, and observed to consist of light gray claystone. The claystone was observed to be very weak rock (R1), very fine-grained, highly weathered, with closely spaced discontinuities in very poor condition. The Latah Formation extends to the depth explored, about 61.5 ft.

Basalt was encountered in boring SSSB-1-00 below the Pleistocene flood deposits at a depth of about 17.5 ft, and in boring PH2-2-00 just below a thin layer of topsoil. At boring SSSB-1-00, the basalt was observed to be dark gray, fine-grained, slightly weathered to fresh, with widely to moderately spaced discontinuities in poor condition, with some infilling of clay. The rock is generally very strong (R4). The basalt extends to the depth explored, about 40.5 ft. At boring PH2-2-00, the basalt was observed to be dark gray, fine-grained, fresh, with moderately to very closely spaced discontinuities in poor to good condition. The rock is generally very strong (R4). The basalt extends to the depth explored, about 30 ft. At boring WAND-2-00, granitic rock was encountered beneath the Pleistocene flood deposits at a depth of about 94 ft and extends to the depth explored, about 99 ft.

3.4 GROUNDWATER

Groundwater was encountered at the time of drilling in borings SSSB-2-00, PH2-3-00, and DP-6-00 at depths of about 35 ft, 29 ft, and 61.5 ft, respectively, below the existing ground surface. Piezometers were installed in 10 of the 12 borings for subsequent measurement of groundwater levels. Table 1 summarizes groundwater levels measured in the piezometers between the dates of December 6, 2000 and January 22, 2001. Groundwater depths were measured by a representative of WSDOT. If present, the first two groundwater measurements at each boring location are shown on the summary logs in Appendix A.

4.0 USE OF THIS REPORT

This geotechnical data report was prepared for the exclusive use of the Washington State Department of Transportation for specific application to this project. The use by others, or for purposes other than intended, is at the user's sole risk. The findings, recommendations, and opinions presented herein are based on review of readily available geologic information, field explorations, and our understanding of the project requirements. Within the limitations of scope, schedule, and budget, information presented in this data report was prepared in accordance with generally accepted professional geotechnical engineering principles and practices in this area at the time this document was prepared. We make no other warranty, either express or implied.

We appreciate the opportunity to provide these services to the Washington State Department of Transportation and look forward to providing further assistance on this project. Please contact either Mr. Edward J. Heavey at 253-926-2493 or Mr. Dennis Stettler at 425-778-0907 if you have any questions regarding the information contained in this data report.

LANDAU ASSOCIATES, INC.

By:

Edward J. Heavey, P.E.
Senior Engineer

And

Dennis R. Stettler, P.E.
Principal

EJH/DRS/jas

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TABLE 1
GROUNDWATER DATA

Boring No.	Station	Ground Elevation (ft)	Depth to Water (ft)								
			Dec. 6, 2000	Dec. 15, 2000	Dec. 22, 2000	Jan. 5, 2001	Jan. 8, 2001	Jan. 10, 2001	Jan. 20, 2001*	Jan. 22, 2001*	Feb. 3, 2001
SSSB-1-00	474 + 57	1843.1	Dry	Dry	25.1		Dry	25.1	Dry		Dry
PH2-1-00	477 + 10	1847.1					Dry	Dry	Dry		Dry
SSSB-2-00	477 + 94	1847.1		35.0	35.0		34.8	35.1	35.2		35.2
DP-6-00	482 + 34	1835.9		55.8	55.2		53.8	54.9	55.8		56.0
PH2-3-00	487 + 17	1871.3		30.3	30.4		30.2			30.4	30.4
PH2-4-00	494 + 46	1871.3	Dry	Dry	Dry						Dry
PH2-5-00	500 + 04	1911.1				Dry					Dry
PH2-6-00	505 + 08	1910.4			Dry						Dry
PH2-7-00	510 + 03	1916.6				Dry					Dry
WAND-2-00	543 + 67	1677.3									

* Water levels measured after pumping

APPENDIX A
FIELD EXPLORATIONS

Subsurface conditions for the Section 2 portion of the North Spokane Corridor project were explored by completing a series of 12 borings along the proposed route. The location of the borings are shown on Figure 2. The borings were completed to depths of approximately 30 to 100 ft between the dates of September 25 through October 23, 2000. The borings PH2-1-00, PH2-4-00, PRY-1-00, and WAND-2-00 were drilled by Crux Subsurface, Inc. of Spokane, Washington (under contract to WSDOT) using a track-mounted, Morooka MST-1100 drill rig and the triple tube drilling method (HWT Casing with an HQ core). The remaining borings for Section 2 were drilled by Ruen Drilling, Inc. of Clark Fork, Idaho (under contract to WSDOT) with a truck-mounted, Mobile B-61 drill rig advancing hollow-stem augers, or HWT casing for borings PH2-5-00, PH2-6-00, and PH2-7-00.

Disturbed samples of the soil encountered in the borings were obtained at periodic intervals using a 2.0-inch, outside-diameter (OD), split-spoon sampler. The sampler was driven into the undisturbed soil ahead of the auger bit with a 140-pound drop hammer falling a distance of approximately 30 inches. The number of blows required to drive the sampler for each six-inch interval of soil penetration, or part thereof, is noted on the boring logs next to the appropriate sampler notation. The number of blows required to drive the sampler the last 12-inches of the 18-inch drive, termed the standard penetration resistance (N), is also noted on the boring logs. Samples of rock core were recovered from borings SSSB-1-00 and PH2-2-00. The core was placed in wooden core boxes and photographed in the field. The Rock Quality Designation (RQD), Fracture Frequency (FF), and Rock Strength (R) were determined in the field for each rock core sample recovered. The values for RQD, FF, and R are shown on the summary logs in this appendix.

Standpipe piezometers were installed in borings SSSB-1-00, PH2-1-00, SSSB-2-00, DP-6-00, PH2-3-00, PH2-4-00, PH2-5-00 PH2-6-00, PH2-7-00, PRY-1-00 WAND-2-00 for subsequent measurement of groundwater levels. Details of the piezometer installation are shown on the summary logs in this appendix. The remaining borings were abandoned in accordance with 173-160 WAC.

The field explorations were coordinated and monitored by a geologist from our staff or by a geologist from Yonemitsu Geologic Services (under subcontract to Landau Associates) who maintained detailed records of encountered subsurface soil and groundwater conditions, obtained representative soil samples, and described the soil by visual and textural examination. The exploration locations, shown on Figure 2, were field-located by WSDOT surveyors. Ground surface elevations at the boring locations

were determined by WSDOT surveyors. Table A-1 provides a summary of the boring locations by stationing and offset, ground surface and casing elevation, and other pertinent data.

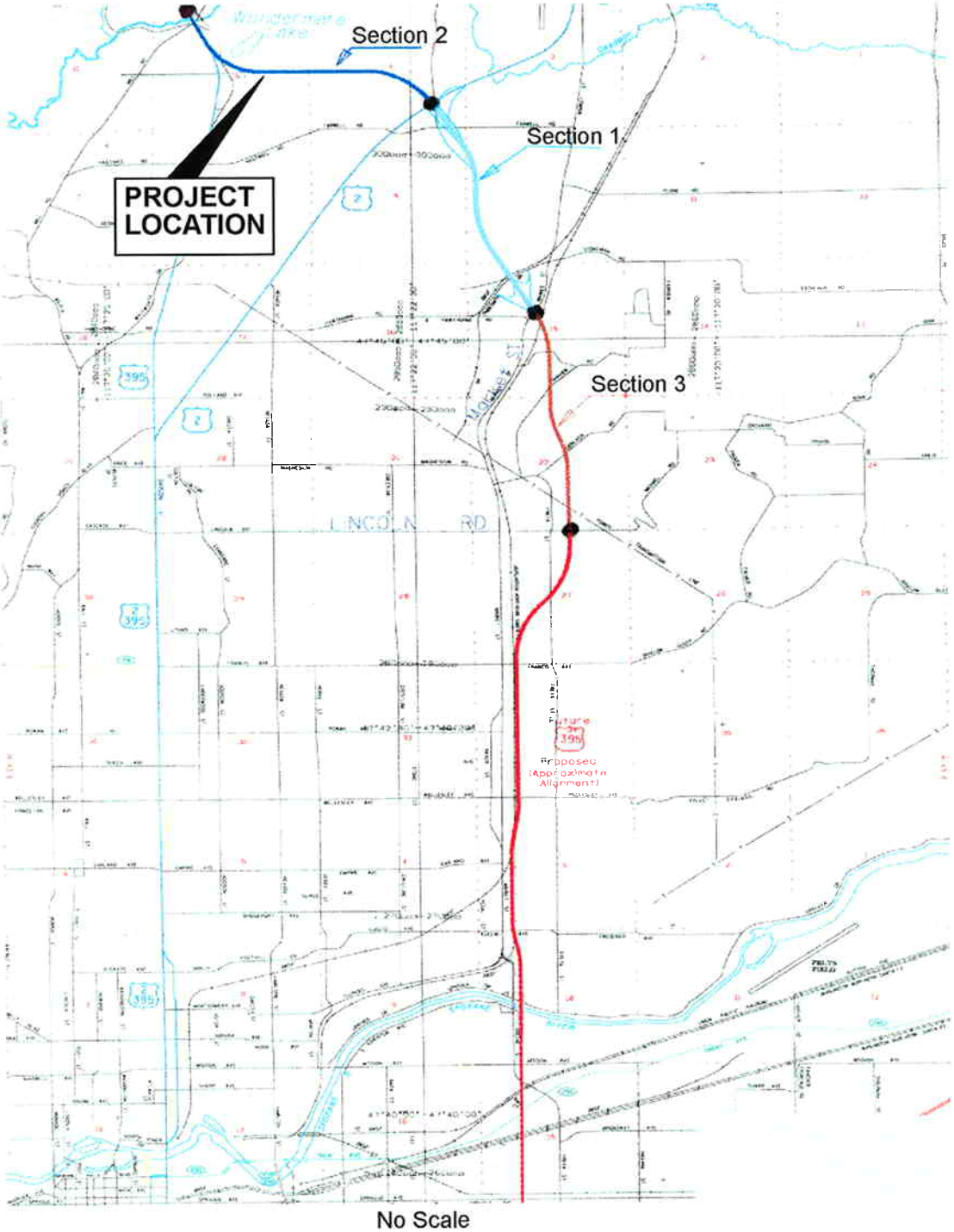
All soil encountered in the borings was described using the WSDOT Soil and Rock Classification System, which is a modified version of the Unified Soil Classification System as outlined in ASTM D2488 *Standard Recommended Practice for Description of Soil (Visual-Manual Procedures)*.

A key to the classification system and the boring logs is presented on Figure A-1 in this appendix. The boring logs are presented on Figures A-2 through A-13.

TABLE A-1

BORING DATA

Proj. No.	Parcel No.	Property Owner	Bore Hole Point #	Bore Hole ID #	Ground Elev at Bore Hole	Pipe or Cap Elev	Station (ft)	Offset (-)=Lt (+)=Rt	Northing (Proj. Datum)	Easting (Proj. Datum)	Piezometer
2	6-05431	Kaiser	BH37755	SSSB-1-00	1843.1	1845.9	474+56.569	291.72	630736.07	2819134.33	YES
2	6-05431	Kaiser	BH37760	PH2-1-00	1847.4	1850.6	477+10.179	7.74	630676.68	2818749.84	YES
2	6-05431	Kaiser	BH37765	SSSB-2-00	1847.1	1849.9	477+94.209	-380.02	630403.39	2818463.75	YES
2	6-05433	RE&M Materne	BH37775	PH2-2-00	1862.4	N / A	481+07.051	-3.37	630876.59	2818406.82	NO
2	6-05431	Kaiser	BH37770	DP-6-00	1835.9	1838.9	482+34.290	-537.06	630452.71	2818062.70	YES
2	6-05433	RE&M Materne	BH37776	PH2-3-00	1871.3	1873.5	487+17.069	5.19	631114.82	2817846.12	YES
2	6-05437	Devlin Entr. Prtn.	BH37712	PH2-4-00	1894.8	1897.7	494+46.462	-0.35	631228.68	2817126.87	YES
2	6-05437	Devlin Entr. Prtn.	BH37717	PH2-5-00	1911.1	1913.9	500+03.976	4.87	631218.35	2816569.60	YES
2	6-05437	Devlin Entr. Prtn.	BH37722	PH2-6-00	1910.4	1913.2	505+07.821	-25.08	631162.07	2816068.01	YES
2	6-05437	Devlin Entr. Prtn.	BH37727	PH2-7-00	1916.6	1919.4	510+03.195	-4.65	631156.55	2815572.25	YES
2	Perry St	Perry St	BH37732	PRY-1-00	1915.5	N / A	513+88.345	3.30	631144.33	2815187.21	NO
2	6-05456	Wandermere	BH37733	WAND-1-00	1677.3	1680.5	543+66.842	-19.23	631463.77	2812290.95	YES



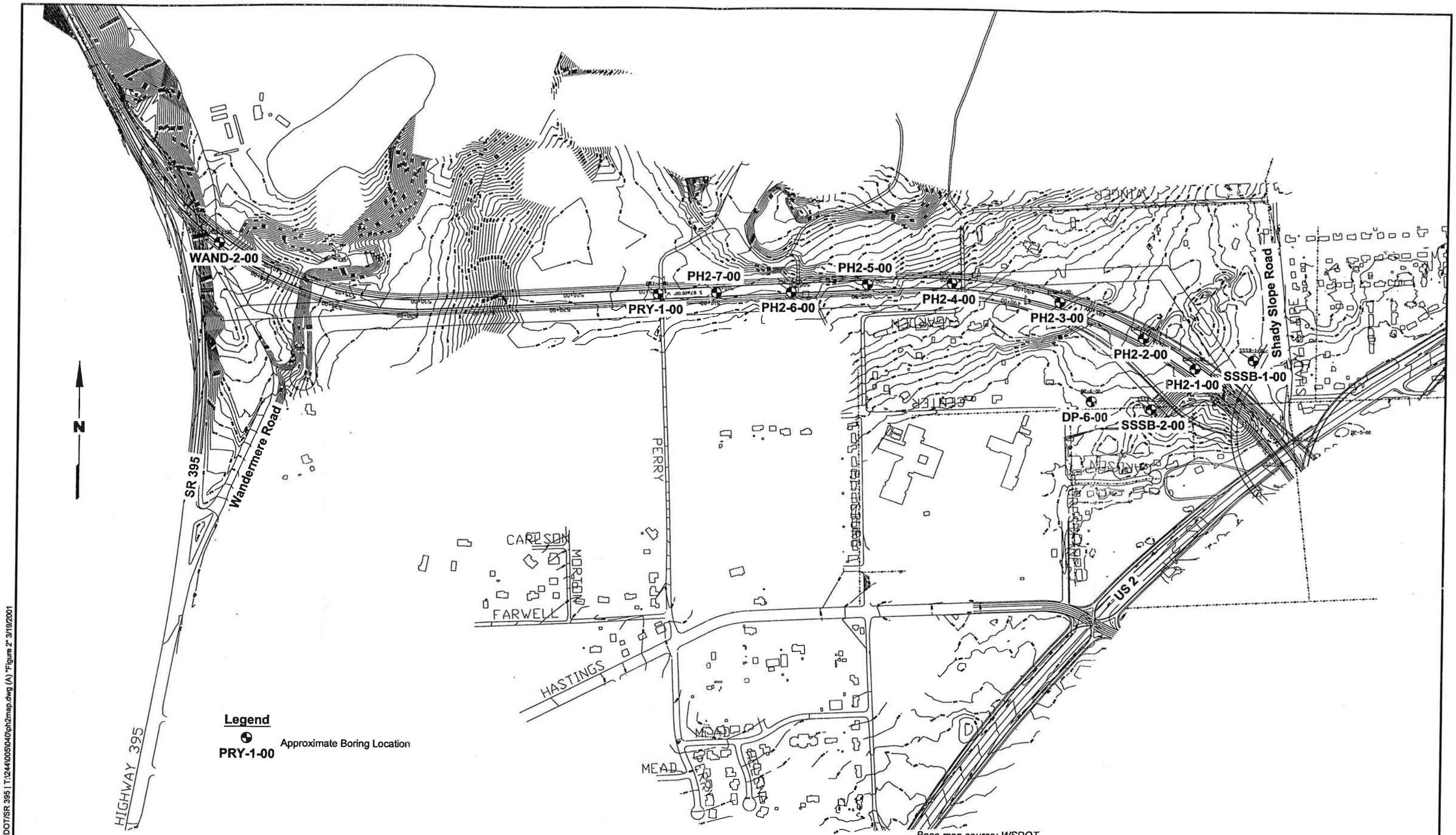
No Scale

Base drawing provided by WSDOT

North Spokane Corridor XL1154 I:\project\244\005.10\vicinity.FH8 12/15/00

Landau Associates

SR 395 North Spokane Corridor Project Spokane, Washington	**Vicinity Map US 2 to SR 395**	Figure 1



Base map source: WSDOT

WSDOT/SR 395 | T:\244\0050\040\ph2\map.dwg (A) *Figure 2* 3/19/2001

Landau Associates

SR 395 North Spokane Corridor Project Spokane, Washington	**Site and Exploration Plan Section 2 - US2 to SR 395**	Figure 2

APPENDIX A

Field Explorations

Washington State Department of Transportation

Test Boring Legend

Sampler Symbols

	Standard Penetration Test
	Oversized Penetration Test (Dames & Moore, California)
	Shelby Tube
P	Piston Sample
	Washington Undisturbed
	Becker Hammer
	Core
G	Grab Sample
B	Bag Sample

Well Symbols

	Cement Surface Seal
	Piezometer Pipe in Granular Bentonite Seal
	Piezometer Pipe in Sand
	Well Screen in Sand
	Granular Bentonite Bottom Seal
	Inclinometer Casing in Concrete Bentonite Grout

Laboratory Testing Codes

UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
UC	Unconfined Compression Test
DS	Direct Shear Test
CN	Consolidation Test
GS	Grain Size Distribution
MC	Moisture Content
SG	Specific Gravity
OR	Organic Content
DN	Density
AL	Atterberg Limits
PT	Point Load Compressive Test
SL	Slake Test
DG	Degradation
LA	LA Abrasion

Soil Density Modifiers

Gravel, Sand & Non-plastic Silt		Elastic Silts and Clay	
SPT Blows/ft	Density	SPT Blows/ft	Consistency
0-4	Very Loose	0-1	Very Soft
5-10	Loose	2-4	Soft
11-24	Medium Dense	5-8	Medium Stiff
25-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

Angularity of Gravel & Cobbles

Angular	Coarse particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Coarse grained particles are similar to angular but have rounded edges.
Subrounded	Coarse grained particles have nearly plane sides but have well rounded corners and edges.
Rounded	Coarse grained particles have smoothly curved sides and no edges.

Soil Moisture Modifiers

Dry	Absence of moisture; dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water

Soil Structure

Stratified	Alternating layers of varying material or color at least 6mm thick; note thickness and inclination.
Laminated	Alternating layers of varying material or color less than 6mm thick; note thickness and inclination.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into smaller angular lumps which resist further breakdown.
Disrupted	Soil structure is broken and mixed. Infers that material has moved substantially - landslide debris.
Homogeneous	Same color and appearance throughout.

HCL Reaction

No HCL Reaction	No visible reaction.
Weak HCL Reaction	Some reaction with bubbles forming slowly.
Strong HCL Reaction	Violent reaction with bubbles forming immediately.

Degree of Vesicularity of Pyroclastic Rocks

Slightly Vesicular	5 to 10 percent of total
Moderately Vesicular	10 to 25 percent of total
Highly Vesicular	25 to 50 percent of total
Scoriaceous	Greater than 50 percent of total

Figure A-1

Washington State Department of Transportation

Test Boring Legend

Grain Size

Fine Grained	< 1mm	Few crystal boundaries/grains are distinguishable in the field or with hand lens.
Medium Grained	1mm to 5mm	Most crystal boundaries/grains are distinguishable with the aid of a hand lens.
Coarse Grained	> 5mm	Most crystal boundaries/grains are distinguishable with the naked eye.

Weathered State

Term	Description	Grade
Fresh	No visible sign of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as core stones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as core stone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength approx
R1	Very Weak	Specimen crumbles under sharp blow from point of geological hammer, and can be cut with a pocket knife.	1 to 25 MPa
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	25 to 50 MPa
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer.	50 to 100 MPa
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	100 to 200 MPa
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 200 MPa

Discontinuities

Spacing

Very Widely	Greater than 3 m
Widely	1 m to 3 m
Moderately	0.3 m to 1 m
Closely	50 mm to 300 mm
Very Closely	Less than 50 mm

RQD (%)

$$\frac{100(\text{length of core in pieces} > 100\text{mm})}{\text{Length of core run}}$$

Condition

Excellent	Very rough surfaces, no separation, hard discontinuity wall
Good	Slightly rough surfaces, separation less than 1 mm, hard discontinuity wall.
Fair	Slightly rough surfaces, separation greater than 1 mm, soft discontinuity wall.
Poor	Slickensided surfaces, or soft gouge less than 5 mm thick, or open discontinuities 1 to 5 mm.
Very Poor	Soft gouge greater than 5 mm thick, or open discontinuities greater than 5 mm.

Fracture Frequency (FF) is the average number of fractures per 300 mm of core.
Does not include mechanical breaks caused by drilling or handling.

Figure A-1

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **SSSB-1-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **474+56.569** Offset **291.72 ft** C.S.

Equipment **B-61** Casing **8-in HSA/HWT** Ground El **1843.1 (561.78 m)**

Method of Boring **HSA**

Start Date **October 13, 2000** Completion Date **October 13, 2000** Sheet **1** of **3**

Depth (ft)	Meters (m)	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material
							Silty SAND with scattered tree roots, loose, moist, homogeneous, no HCL reaction, (Qf)
5	1		20 22 23 (45)		D-1		Well graded SAND with gravel, subrounded, dense, light brown, moist, homogeneous, no HCL reaction, (Qf)
10	3		4 6 12 (18)		D-2	GS MC = 1	Well graded SAND, rounded, medium dense, brown, moist, homogeneous, no HCL reaction, (Qf)
15	5	>>	24 40 50/4"		D-3		Well graded SAND with gravel and scattered cobbles, subrounded, very dense, brown, moist, homogeneous, strong HCL reaction, (Qf)
20	6						Soil drilling halted due to rock. Log continues on following page.

Groundwater / Instrument

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/14/01 4:33:12 P3

Figure A-2 Page (1 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **SSSB-1-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **474+56.569** Offset **291.72 ft** C.S.

Equipment **B-61** Casing **8-in HSA/HWT** Ground El **1843.1 (561.78 m)**

Method of Boring **HSA**

Start Date **October 13, 2000** Completion Date **October 13, 2000** Sheet **2** of **3**

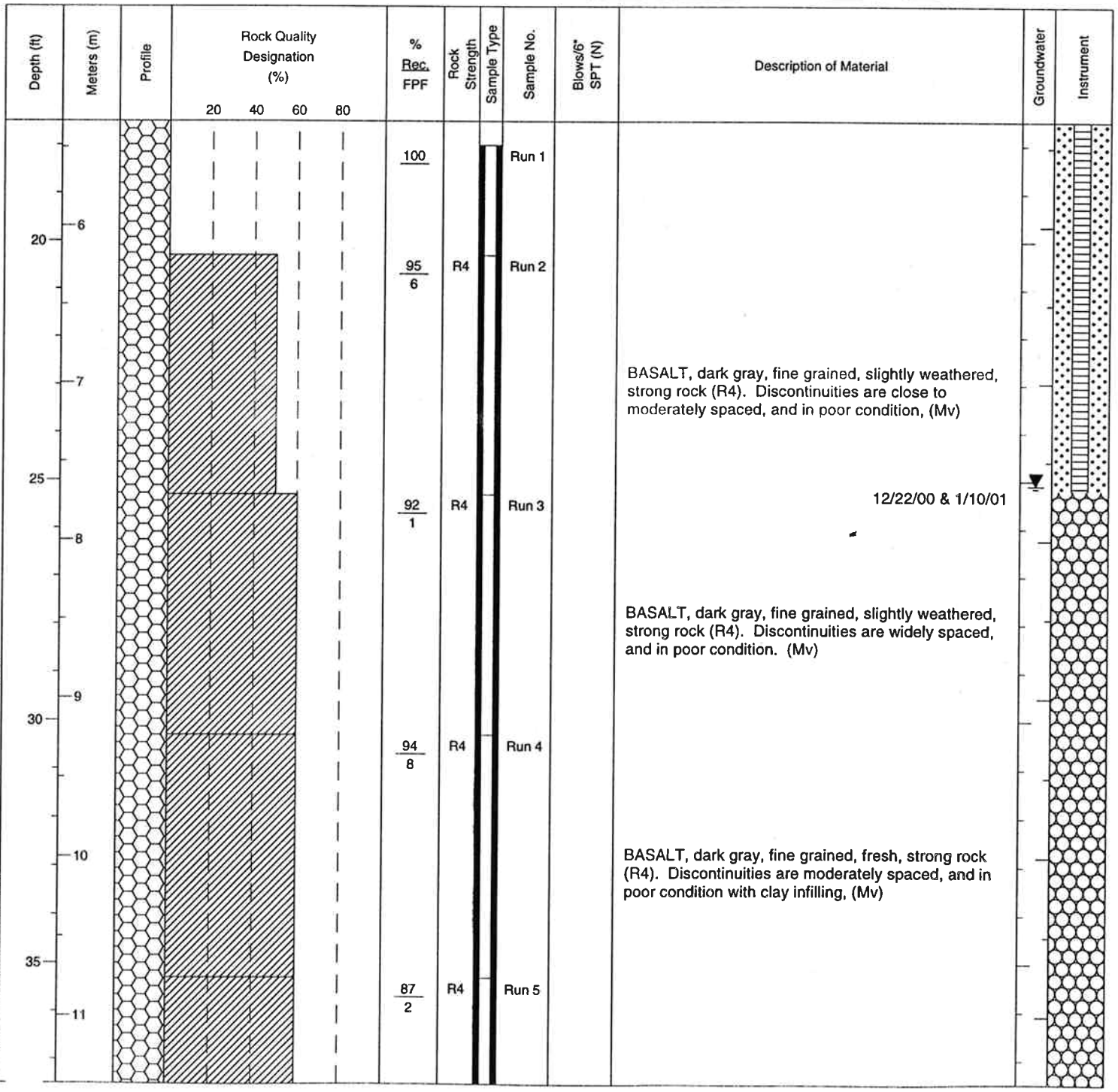


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Figure A-2 Page (2 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **SSSB-1-00**

Sheet **3** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. FPF	Rock Strength	Sample Type	Sample No.	Blows/6" SPT (N)	Description of Material	Groundwater	Instrument
40	12								BASALT, dark gray, fine grained, fresh, strong rock (R4). Discontinuities are moderately spaced, and in poor condition. (Mv)		
	13										
45	14										
	15										
50	16										
55	17										
	18										
60	19										

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Figure A-2 Page (3 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-1-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **477+10.179** Offset **7.74 ft** C.S.

Equipment **B-61** Casing **8-in HSA** Ground El **1847.4 (563.09 m)**

Method of Boring **HSA**

Start Date **October 9, 2000** Completion Date **October 9, 2000** Sheet **1** of **3**

Depth (ft)	Meters (m)	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material
5	1		13 18 22 (30)		D-1		Silty SAND with gravel and cobbles, angular to subrounded, dense, brown, moist, (Qf)
10	3	>>	28 28 31 (59)		D-2	GS MC = 1	Silty SAND with basalt gravel and cobbles, angular to subrounded, very dense, brown, moist (Qf)
15	5		8 10 11 (21)		D-3		Silty SAND with trace of basalt gravel, rounded to subangular, medium dense, brown, moist, homogeneous, (Qf)
20	6						

Groundwater

Instrument

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/26/01 1:41:38 P3

Figure A-3 Page (1 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-1-00**

Sheet **2** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				10 17 18 (35)		D-4	GS MC = 33	Silty SAND, subrounded, dense, brown, moist, homogeneous, (Qf)		
25	7			10 31 46 (76)		D-5		Silty SAND, rounded to subrounded, dense, brown, moist, homogeneous, (Qf)		
30	9			12 14 20 (34)		D-6	GS MC = 11	Silty SAND interbedded with coarse sand, rounded, dense, brown, moist, stratified, (Qf) Poorly graded SAND, dense, rounded, brown, moist		
35	10			25 29 (54)		D-7		Well graded SAND with trace of gravel, subrounded, brown, moist, strong HCL reaction, (Qf)		
40	12			16 20 43 (63)		D-8	MC = 17 AL	Lean CLAY with coarse sand and fine gravel, very hard, reddish brown, moist, stratified with high angle bedding, no HCL reaction, (Mc)		
45	13									

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Figure A-3 Page (2 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-1-00**

Sheet **3** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14	>>	15 32 48 (80)		D-9		Lean CLAY with trace of fine gravel, very hard, reddish brown, moist, no HCL reaction, (Mc)		
	15								
50		>>	14 22 31 (53)		D-10	GS MC = 16 AL	Lean CLAY, hard, brown, moist, no HCL reaction, (Mc)		
	16								
55		>>	50/3"		D-11		Lean CLAY, very hard, brown, moist, no HCL reaction, scattered cobbles (Mc) Gravelly between 56 and 57 ft. Scattered cobbles below 57 ft.		
	17								
	18								
60		>>	50/0"		D-12		refusal on basalt (?)		
	19								
65									
	20								
	21								
70									

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/26/01 11:41:40 P3

Figure A-3 Page (3 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **SSSB-2-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **477+94.209** Offset **-380.02 ft** C.S.

Equipment **B-61** Casing **8-in HSA** Ground El **1847.1 (563.00 m)**

Method of Boring **HSA**

Start Date **October 10, 2000** Completion Date **October 10, 2000** Sheet **1** of **3**

Depth (ft)	Meters (m)	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material
5	1–2		5 5 5 (10)		D-1	GS MC = 6	Silty SAND, rounded, loose, light brown, moist, homogeneous, no HCL reaction, (Qf)
10	3–4		6 5 7 (12)		D-2		Poorly graded, fine to medium SAND with silt, medium dense, brown, moist, homogeneous, no HCL reaction, (Qf)
15	5		6 6 4 (10)		D-3		Poorly graded, coarse SAND with trace of coarse gravel, subrounded, loose, brown, moist, homogeneous, no HCL reaction, (Qf)
20	6						

Groundwater / Instrument

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LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **SSSB-2-00**

Sheet **2** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

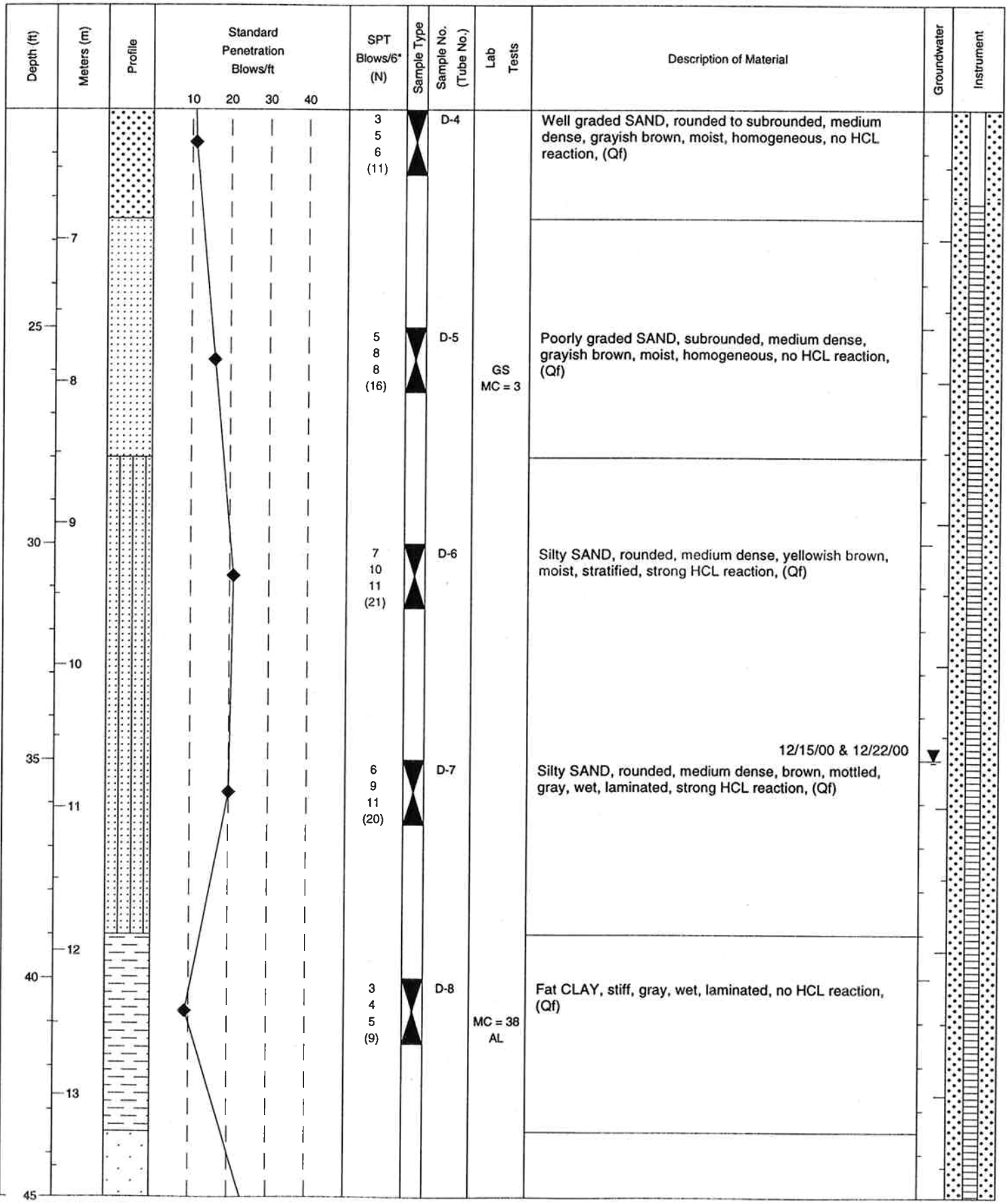

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Figure A-4 Page (2 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **SSSB-2-00**

Sheet 3 of 3

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				12 14 12 (26)		D-9		SILT with sand, dense, moist, laminated, no HCL reaction, (Qf) Well graded SAND, subrounded, dense, moist, brown, homogeneous, no HCL reaction, (Qf)		
50	14 15		>>	8 22 32 (54)		D-10		Poorly graded SAND interbedded with fat clay, subrounded, very dense, brown, moist, stratified, no HCL reaction, (Qf)		
55	16 17									
60	18									
65	19 20									
70	21									

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Figure A-4 Page (3 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-2-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **481+07.051** Offset **-3.37 ft** C.S.

Equipment **Morooka MST-1100** Casing **HWT** Ground El **1862.4 (567.66 m)**

Method of Boring **HQ casing advance**

Start Date **October 23, 2000** Completion Date **October 23, 2000** Sheet **1** of **2**

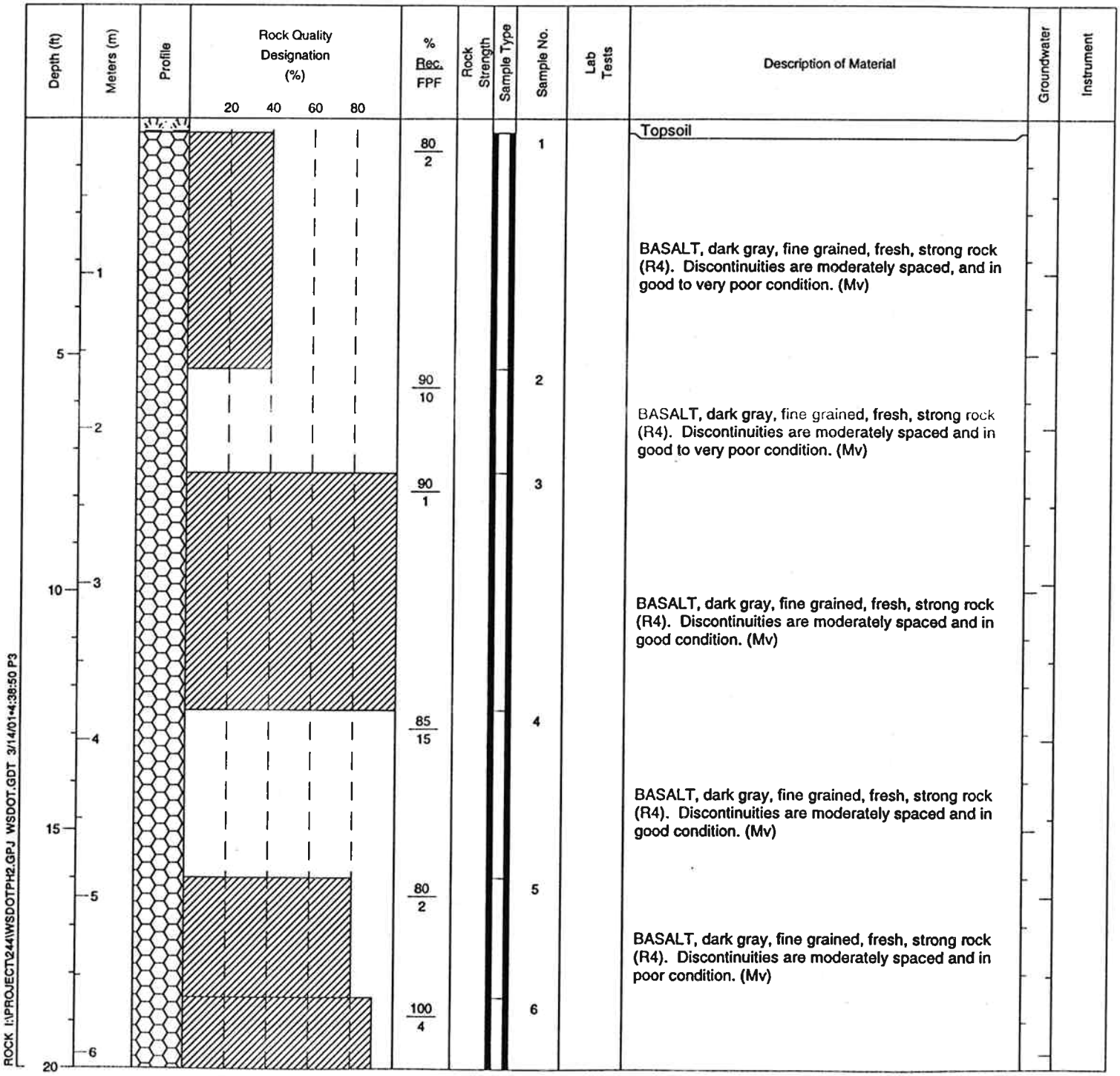

Figure A-5 Page (1 of 2)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-2-00**

Sheet 2 of 2

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

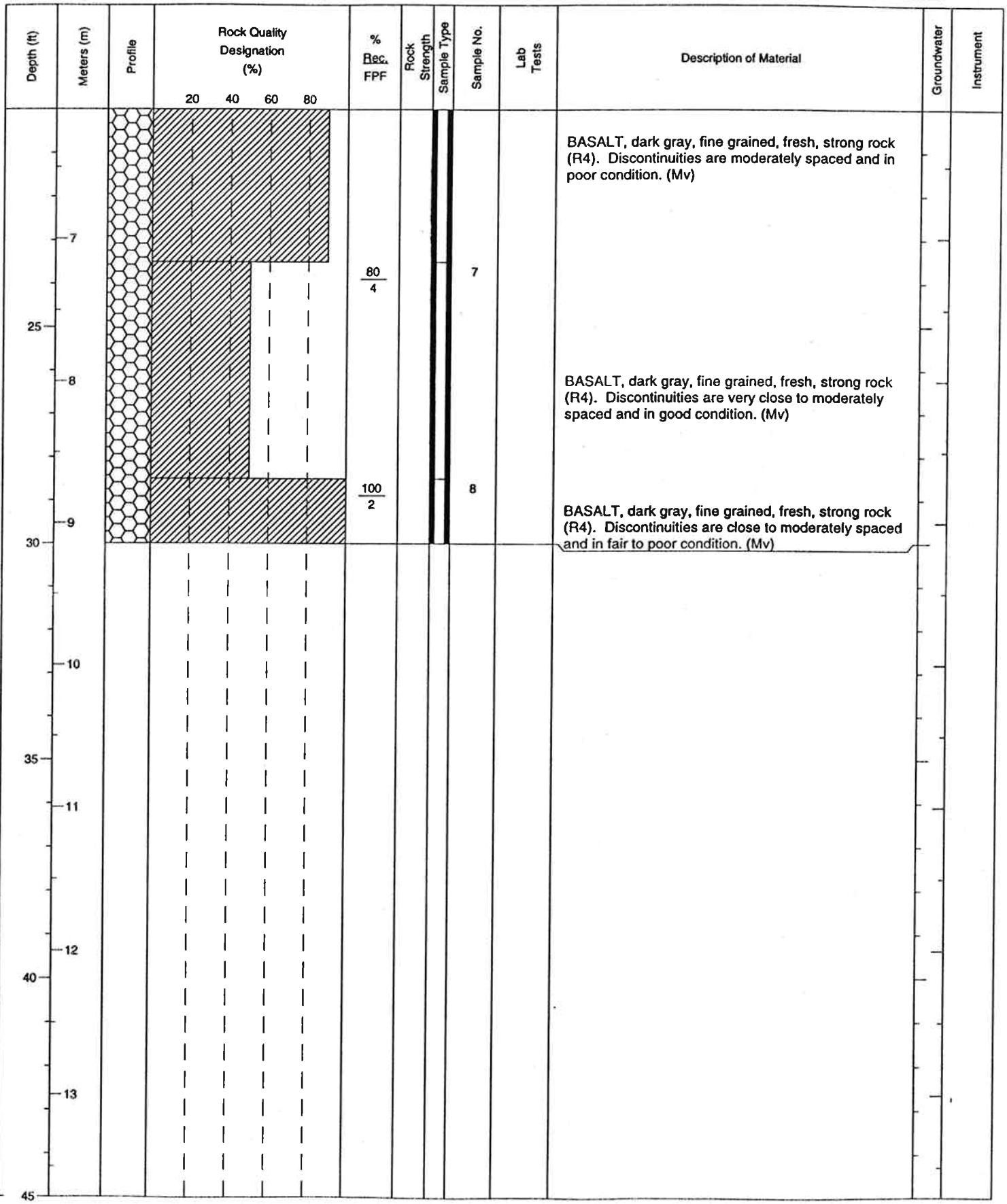

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Figure A-5 Page (2 of 2)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **DP-6-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **482+34.299** Offset **-537.06 ft** C.S.

Equipment **B-61** Casing **8-in HSA** Ground El **1835.9 (559.58 m)**

Method of Boring **HSA**

Start Date **October 10, 2000** Completion Date **October 10, 2000** Sheet **1** of **3**

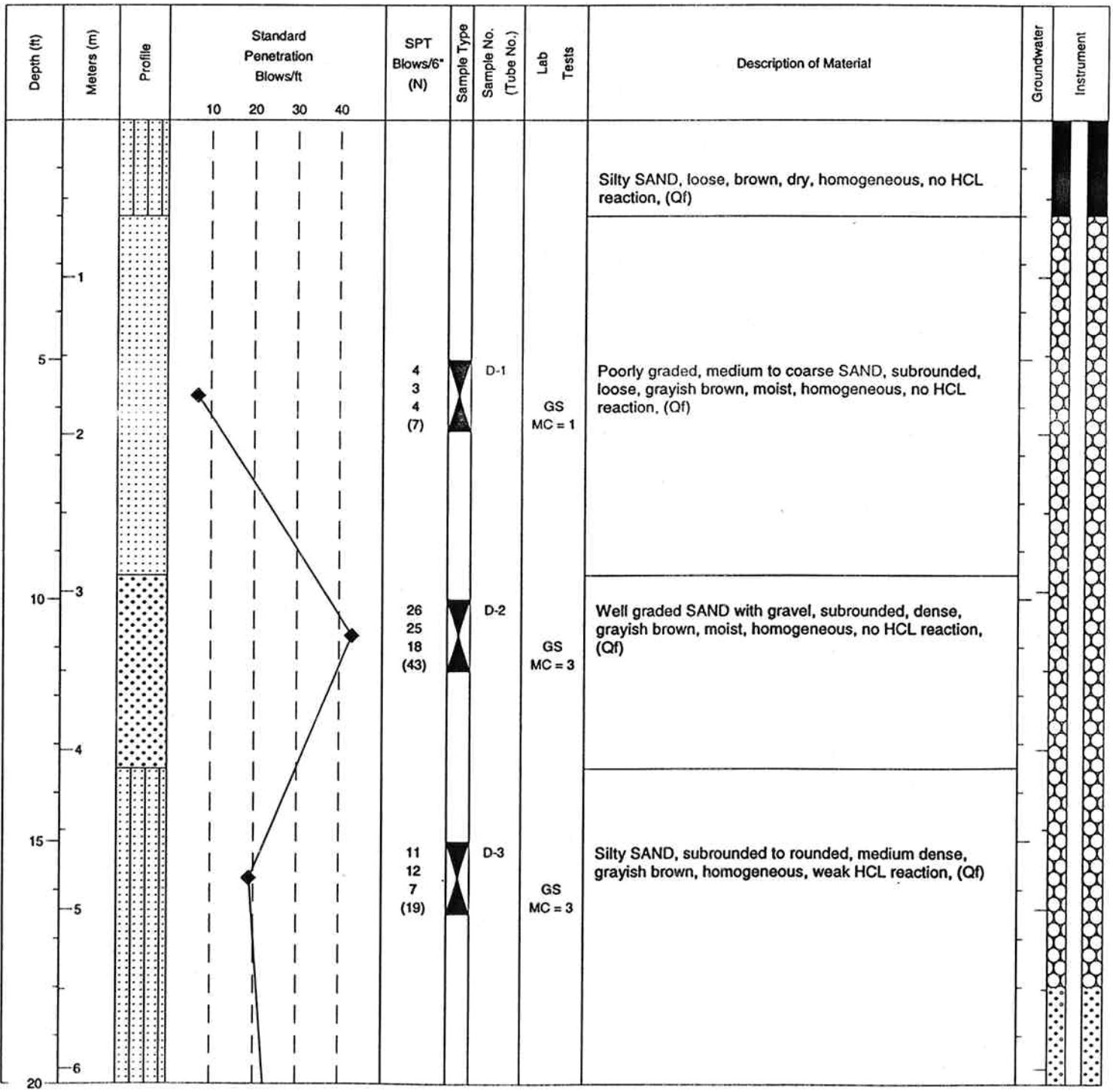

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Figure A-6 Page (1 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **DP-6-00**

Sheet **2** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

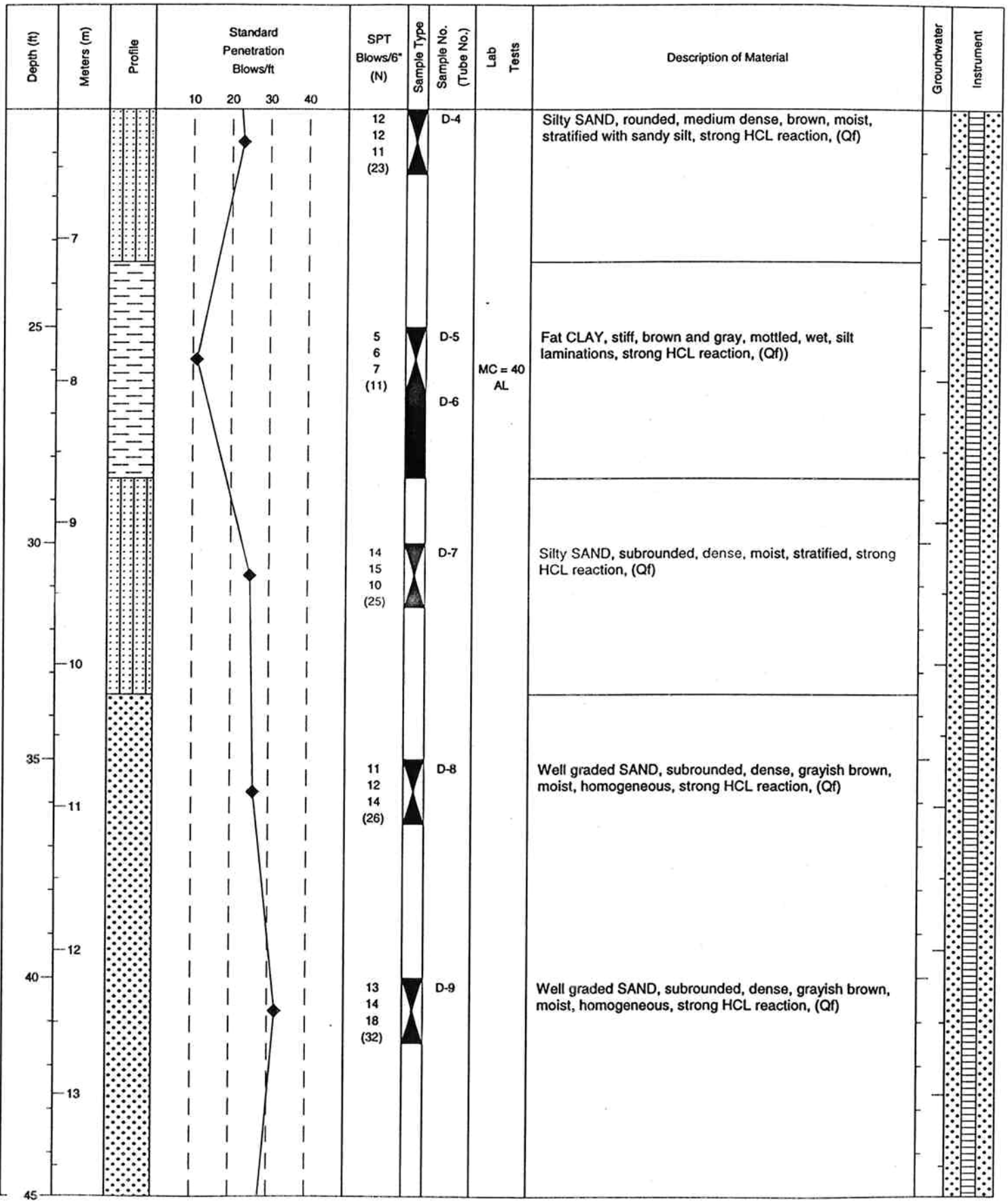

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Figure A-6 Page (2 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **DP-6-00**

Sheet **3** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

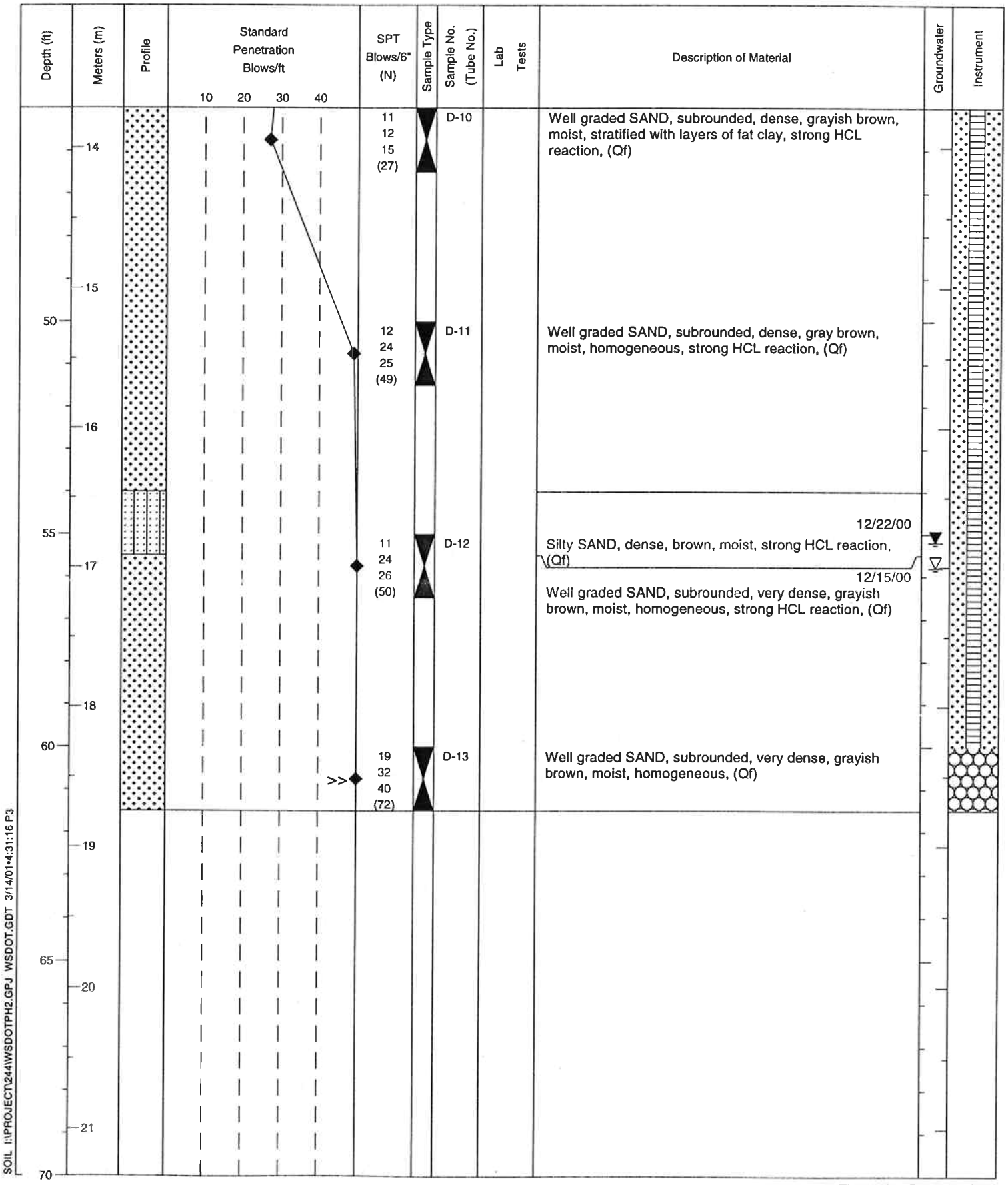

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Figure A-6 Page (3 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-3-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **487+17.069** Offset **5.19 ft** C.S.

Equipment **B-61** Casing **8-in HSA** Ground El **1871.3 (570.37 m)**

Method of Boring **HSA**

Start Date **October 11, 2000** Completion Date **October 11, 2000** Sheet **1** of **2**

Depth (ft)	Meters (m)	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1	>>	4 50/3"		D-1	MC = 1	Well graded SAND, subrounded, very dense, grayish brown and orange, mottled, moist, homogeneous, no HCL reaction, (Qf)		
10	3	>>	17 49 50/5"		D-2		Silty GRAVEL with sand and scattered cobbles, subrounded, very dense, grayish brown, moist, homogeneous, no HCL reaction, (Qf)		
15	5		5 4 7 (11)		D-3		Silty GRAVEL with sand and scattered cobbles, subrounded, medium dense, grayish brown, moist, homogeneous, weak HCL reaction, (Qf)		
20	6								

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/14/01 4:31:48 P3

Figure A-7 Page (1 of 2)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-3-00**

Sheet 2 of 2

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 5 18 (13)		D-4		Poorly graded silty GRAVEL with sand and scattered cobbles, subangular, medium dense, grayish brown, moist, homogeneous, no HCL reaction, (Qf)		
25	7			38 18 11 (29)		D-5		Poorly graded sandy GRAVEL and scattered cobbles, subangular, dense, grayish brown, moist, homogeneous, no HCL reaction, gravel pieces coated with clay, (Qf)		
30	9			13 12 24 (36)		D-6	GS MC = 23	Silty SAND with gravel, rounded, dense, grayish brown, wet, stratified, no HCL reaction, (Qf) 12/15/00 & 12/19/00	▽	
35	10									
	11									
40	12									
45	13									

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/14/01 4:31:50 P3

Figure A-7 Page (2 of 2)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-4-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **494+46.462** Offset **-0.35 ft** C.S.

Equipment **Morooka MST-1100** Casing **HWT/HQ** Ground El **1894.8 (577.54 m)**

Method of Boring **HQ casing advance**

Start Date **October 6, 2000** Completion Date **October 6, 2000** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								Dry organic debris		
5	1			4 4 4 (8)		D-1	MC = 1	Poorly graded, fine to medium SAND, subangular to rounded, loose, brown, moist, homogeneous, (Qf)		
10	3			3 4 6 (10)		D-2		Poorly graded, fine to medium SAND, rounded to subangular, loose, brown, moist, homogeneous (Qf)		
	4							Gravel 12.5 to 13 ft. approximately 10-inch basalt cobble at 13 ft. Note: boring advanced from 13.1 to 30 ft with HQ drilling		
15	5			5 8 11 (19)		D-3	MC = 17	Poorly graded, fine to medium SAND, rounded to subrounded, medium dense, brown, moist, homogeneous, (Qf)		
20	6									

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/14/01 4:32:00 P3

Figure A-8 Page (1 of 2)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-4-00**

Sheet **2** of **2**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

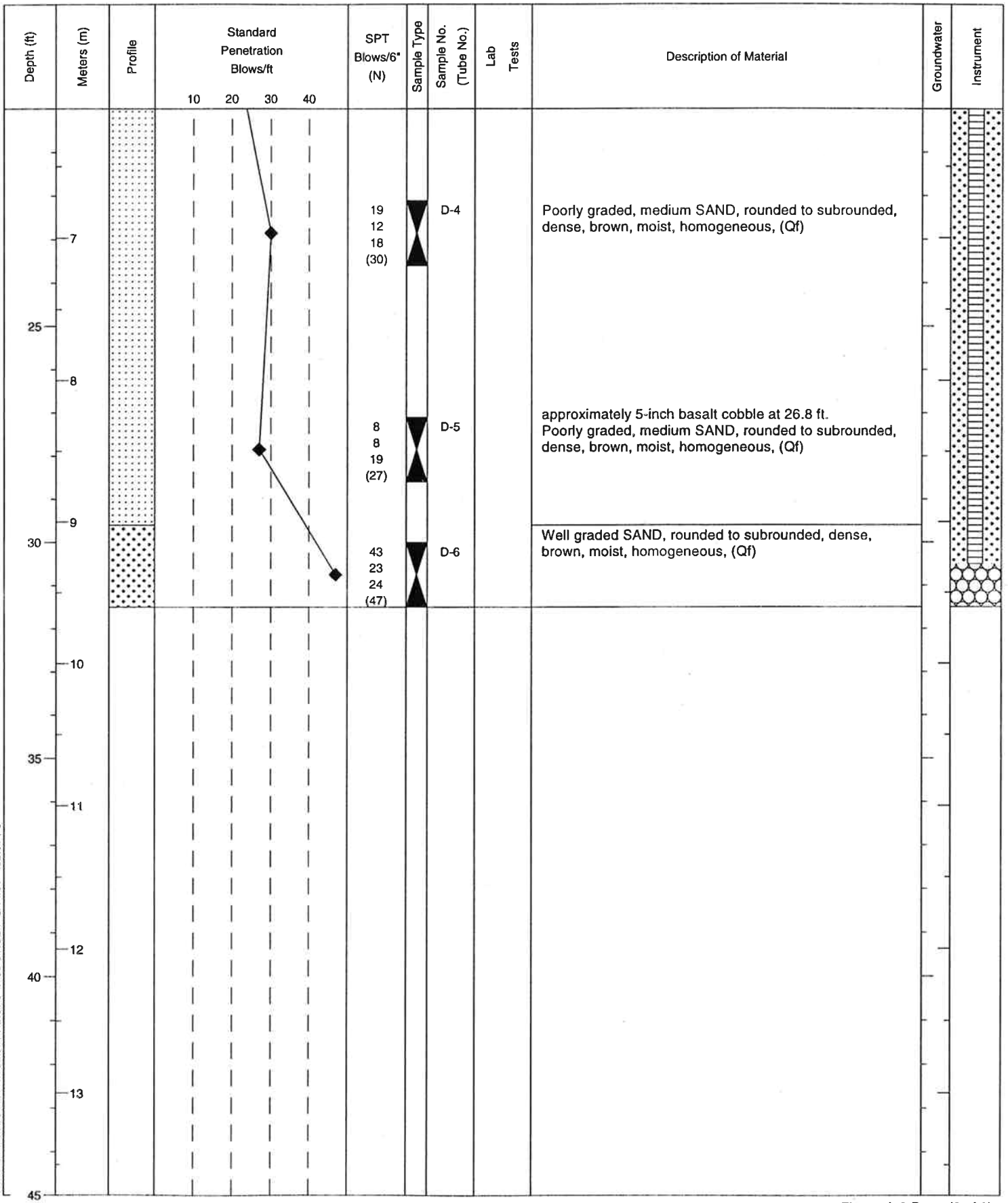

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Figure A-8 Page (2 of 2)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-5-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **Approx. 500+20** Offset **Approx. 5 ft** C.S.

Equipment **B-61** Casing **HWT** Ground El **Approx. 1911 (m)**

Method of Boring **HWT Casing/HQ cassing advance**

Start Date **October 6, 2000** Completion Date **October 6, 2000** Sheet **1** of **4**

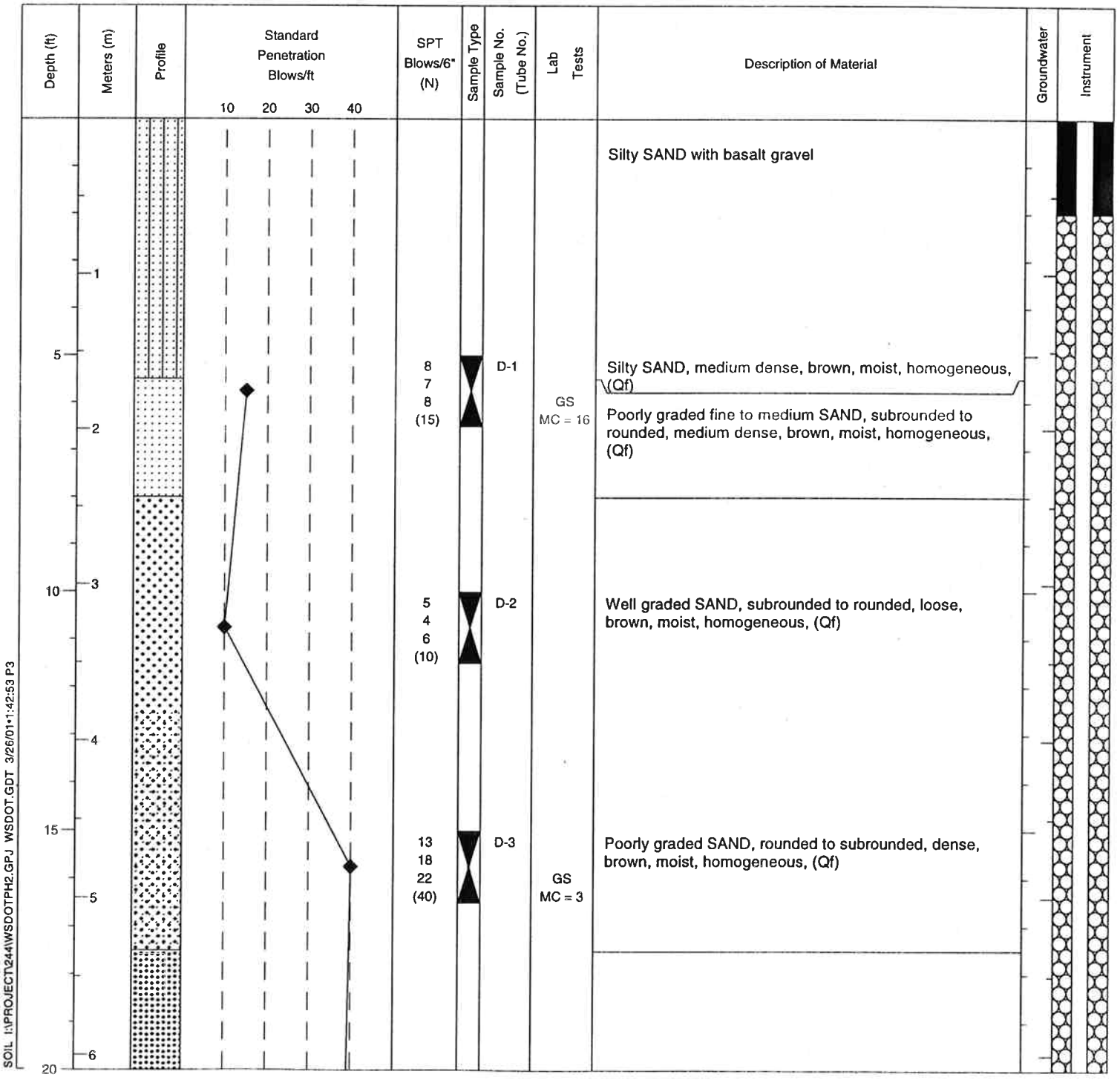

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Figure A-9 Page (1 of 4)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. PH2-5-00

Sheet 2 of 4

PROJECT SR395 North Spokane Corridor Project

Job No. XL1154

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				14 18 20 (39)		D-4		Well graded SAND, rounded to subangular, dense, brown, moist, homogeneous, (Qf)		
25	7			13 16 18 (34)		D-5		Well graded SAND, rounded to subangular, dense, brown, moist, homogeneous, (Qf)		
30	9							Well graded SAND with basalt cobbles and fresh angular gravel-sized basalt fragment, very dense, moist, homogeneous, (Qf) Soil drilling halted due to rock. Log continues on following page.		
35	10									
40	11									
45	12									
	13									

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/26/01 1:42:54 P3

Figure A-9 Page (2 of 4)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-5-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **Approx. 500+20** Offset **Approx. 5 ft** C.S.

Equipment **B-61** Casing **HWT** Ground El **Approx. 1911 (m)**

Method of Boring **HWT Casing/HQ cassing advance**

Start Date **October 6, 2000** Completion Date **October 6, 2000** Sheet **3** of **4**

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)	% Rec. FPF	Rock Strength	Sample Type	Sample No.	Blows/6" SPT (N)	Description of Material	Groundwater	Instrument
30				100			Run 1		Poorly graded, fine SAND with basalt cobbles and gravel, dense, brown, wet, no HCL reaction, (Qf)		
							D-6	50/5"			
				20			Run 2		Poorly graded COBBLES with boulders, very dense, dark gray, homogeneous, no HCL reaction, (Qf)		
	10			100			Run 3				
				50			Run 4				
35				40			Run 5				
							D-7	40	COBBLES with clay, very dense, dark gray, homogeneous, moist, no HCL reaction, (Qf)		
	11							46			
								50/4"	Refusal on basalt cobbles. Boring moved 15 west and redrilled to 29.5 ft. Switched to HQ drilling from 29.5 to 51.3 ft.		
	12										
40				40			D-8	1	COBBLES with clay, very dense, dark gray, homogeneous, moist, no HCL reaction, (Qf)		
							Run 6	9			
	13							50			
45							D-9	50			
								41			
	14							32			
				50	R1		Run 7		CLAYSTONE, Light gray to tan, very fine grained, highly weathered, very weak rock, potential for slaking, discontinuities are closely spaced and in poor condition with iron oxide staining, (Mc)		
	15										

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LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-5-00**

Sheet **4** of **4**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%) 20 40 60 80	% Rec. FPF	Rock Strength	Sample Type	Sample No.	Blows/6" SPT (N)	Description of Material	Groundwater	Instrument
50							D-10	6 12 20	CLAYSTONE, Light gray to tan, very fine grained, highly weathered, very weak rock, potential for slaking, discontinuities are closely spaced and in poor condition with iron oxide staining, (Mc)		
	16										
55											
	17										
	18										
60											
	19										
65											
	20										
	21										
70											
	22										

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Figure A-9 Page (4 of 4)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-6-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **505+07.821** Offset **-25.08 ft** C.S.

Equipment **B-61** Casing **HWT** Ground El **1910.4 (582.29 m)**

Method of Boring **HWT**

Start Date **October 17, 2000** Completion Date **October 17, 2000** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			5 6 7 (13)		D-1		Well graded SAND, rounded, medium dense, brown, moist, homogeneous, no HCL reaction, (Qf)		
10	3			7 10 10 (20)		D-2		Well graded SAND, rounded, medium dense, brown, wet, homogeneous, no HCL reaction, (Qf)		
15	5			4 10 15 (25)		D-3	GS MC = 13	Poorly graded SAND with trace of gravel, subrounded, dense, brown, wet, homogeneous, strong HCL reaction, (Qf)		
20	6									

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LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-6-00**

Sheet **2** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

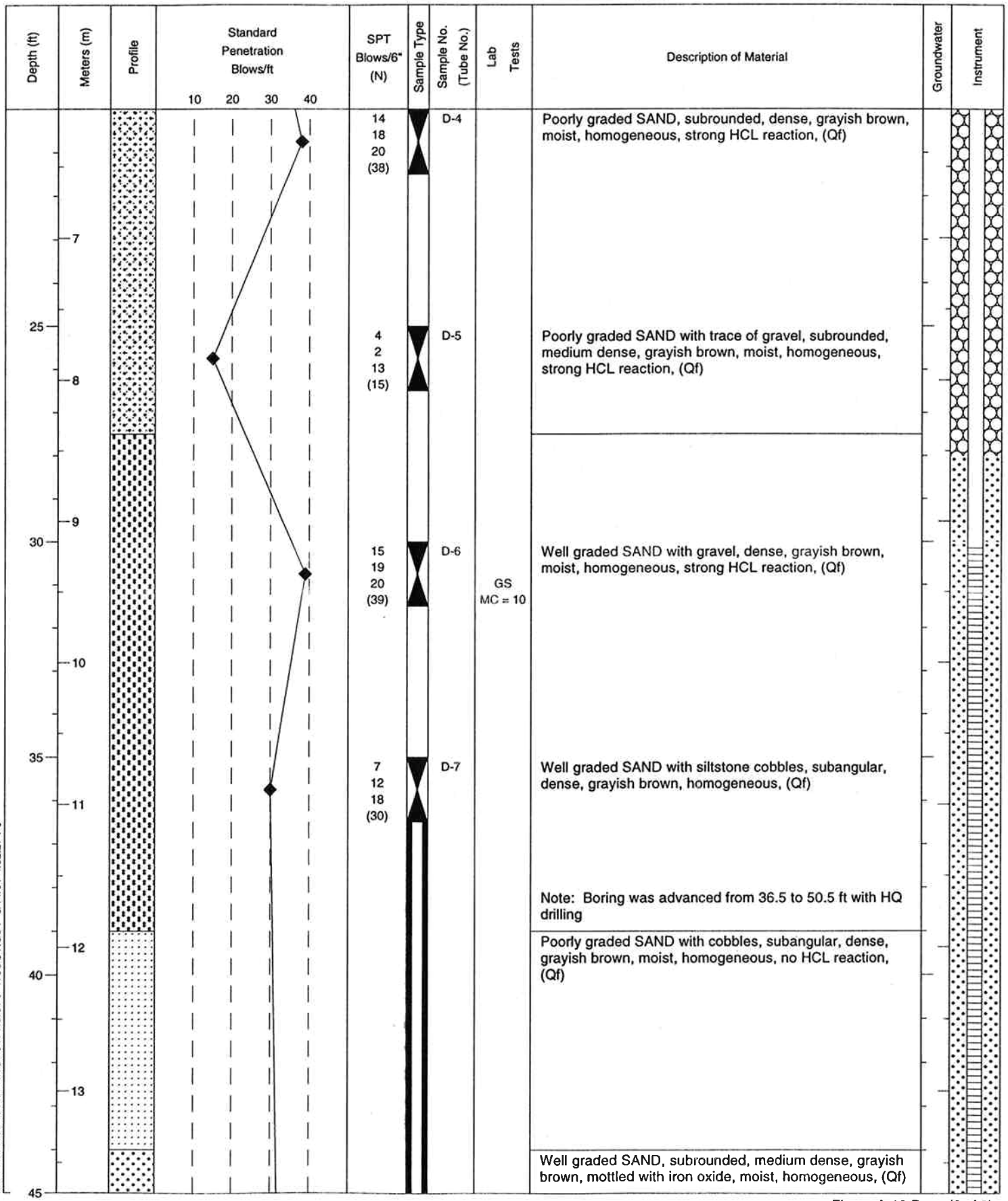

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Figure A-10 Page (2 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-6-00**

Sheet **3** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			7 13 19 (32)		D-8		Well graded SAND, subrounded, dense, grayish brown, mottled with iron oxide, moist, homogeneous, no HCL reaction, (Qf)		
	15									
50			>>	25 50/4"		D-9		Poorly graded SAND, subrounded, very dense, grayish brown, mottled with iron oxide, moist, homogeneous, no HCL reaction, (Qf)		
	16									
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

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Figure A-10 Page (3 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-7-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **510+03.195** Offset **-4.65 ft** C.S.

Equipment **B-61** Casing **HWT** Ground El **1916.4 (584.12 m)**

Method of Boring **HWT**

Start Date **October 18, 2000** Completion Date **October 18, 2000** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								TOPSOIL		
5	1			8 9 9 (18)		D-1		Poorly graded SAND with trace of gravel, rounded to subrounded, medium dense, brown, moist, homogeneous, no HCL reaction, (Qf)		
10	3			5 6 4 (10)		D-2		Well graded SAND, subrounded, loose, grayish brown, homogeneous, strong HCL reaction (Qf)		
15	5			4 8 12 (20)		D-3	MC = 14 GS GS MC = 14	Well graded SAND with trace of fine gravel, subrounded, medium dense, grayish brown, moist, homogeneous, strong HCL reaction, (Qf)		
20	6									

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Figure A-11 Page (1 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-7-00**

Sheet **2** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

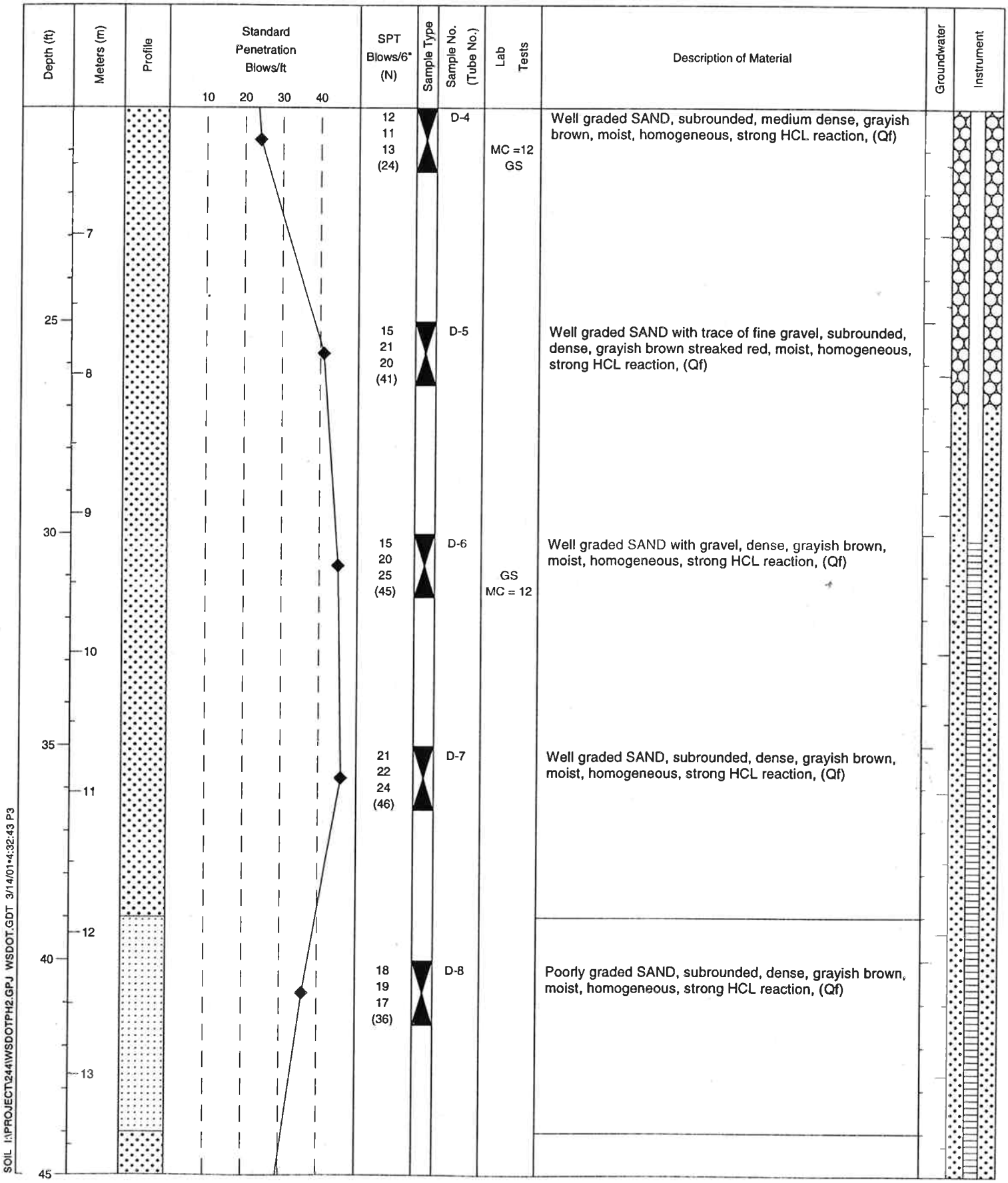

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Figure A-11 Page (2 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PH2-7-00**

Sheet **3** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			11 13 15 (28)		D-9		Well graded SAND with trace of gravel, subrounded, dense, grayish brown, wet, homogeneous, strong HCL reaction, (Qf)		
	15									
50				15 21 22 (43)		D-10		Well graded SAND with trace of gravel, subrounded, dense, grayish brown, wet, homogeneous, strong HCL reaction, (Qf)		
	16									
55	17									
	18									
60										
	19									
65	20									
	21									
70										

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/14/01 4:32:44 P3

Figure A-11 Page (3 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PRY-1-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **512+88.345** Offset **3.30 ft** C.S.

Equipment **Morooka MST-1100** Casing **HWT** Ground El **1915.5 (583.84 m)**

Method of Boring **HQ casing advance**

Start Date **September 25, 2000** Completion Date **September 26, 2000** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			7 6 5 (11)		D-1		Well graded SAND, rounded to subrounded, medium dense, brown, moist, homogeneous, (Qf)		
10	3			5 6 7 (13)		D-2	GS MC = 10	Poorly graded SAND, rounded to subrounded, medium dense, brown, moist, homogeneous, (Qf)		
15	5			13 14 17 (32)		D-3		Well graded SAND, rounded to subrounded, dense, brown, moist, homogeneous, (Qf)		
20	6			10		D-4				

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Figure A-12 Page (1 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PRY-1-00**

Sheet **2** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

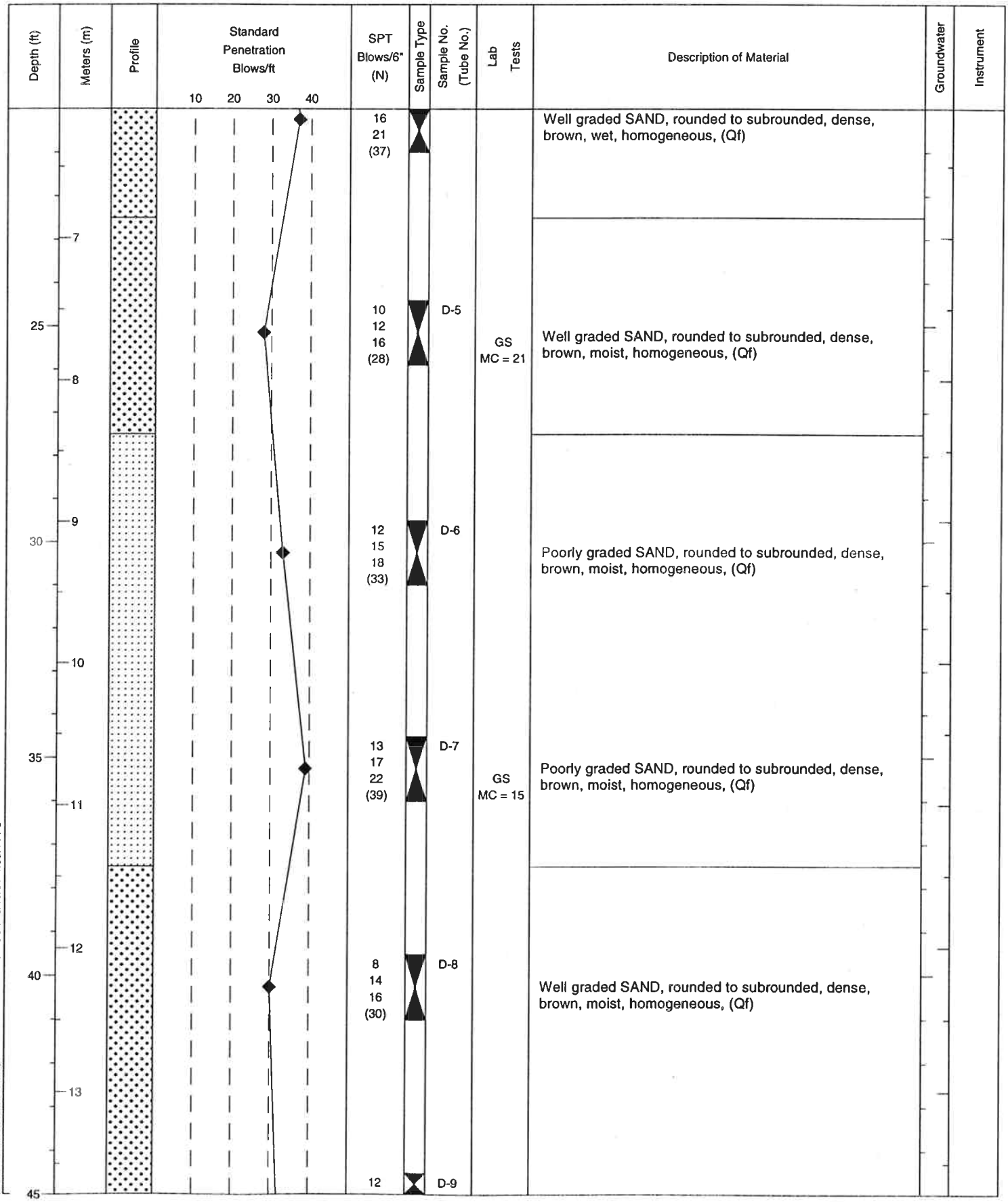

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Figure A-12 Page (2 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **PRY-1-00**

Sheet **3** of **3**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			14 18 (32)				Well graded SAND, rounded to subrounded, dense, brown, moist, homogeneous, (Qf)		
	15									
50				15 14 17 (31)		D-10		Well graded SAND with trace of fine gravel, rounded to subrounded, dense, brown, moist, homogeneous, (Qf)		
	16									
55	17									
	18									
60										
	19									
65										
	20									
	21									
70										

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Figure A-12 Page (3 of 3)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **WAND-2-00**

PROJECT **SR395 North Spokane Corridor Project** Job No. **XL1154**

Spokane, Washington S.R. **395**

Station **543+66.842** Offset **-19.23 ft** C.S.

Equipment **Morooka MST-1100** Casing **HWT** Ground El **1677.3 (511.24 m)**

Method of Boring **HQ casing advance**

Start Date **September 28, 2000** Completion Date **September 30, 2000** Sheet **1** of **5**

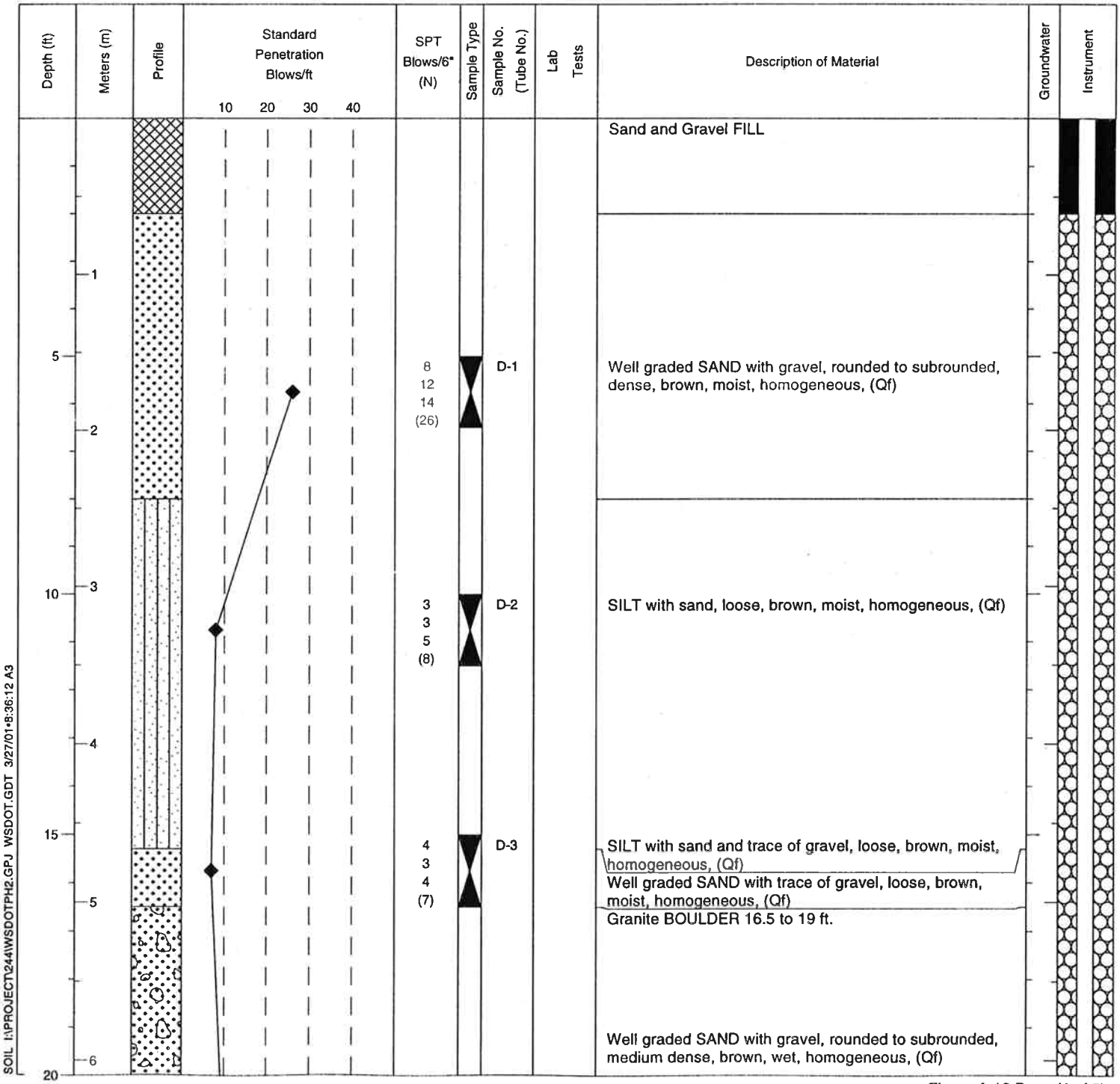

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Figure A-13 Page (1 of 5)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **WAND-2-00**

Sheet **2** of **5**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

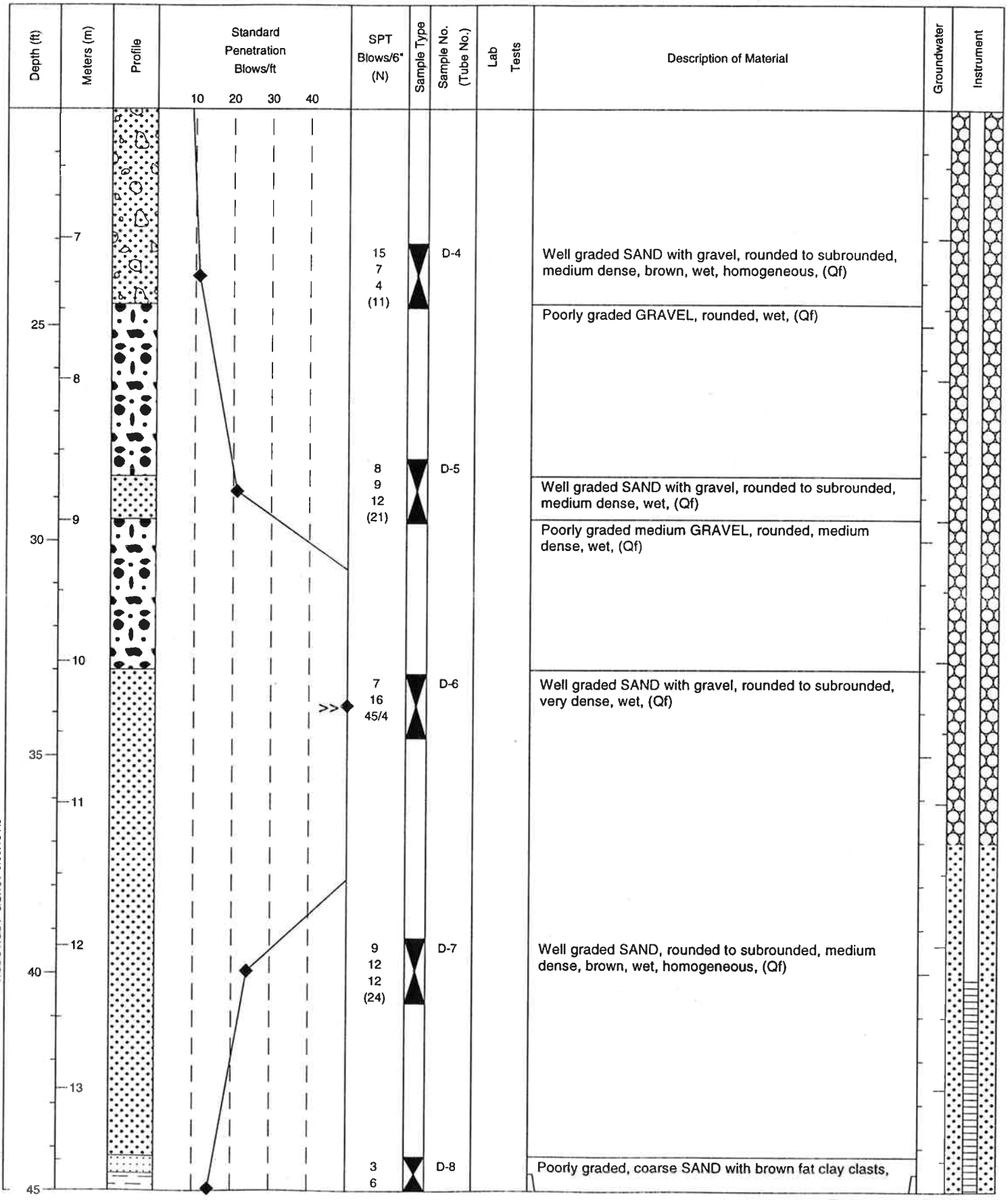

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Figure A-13 Page (2 of 5)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **WAND-2-00**

Sheet 3 of 5

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

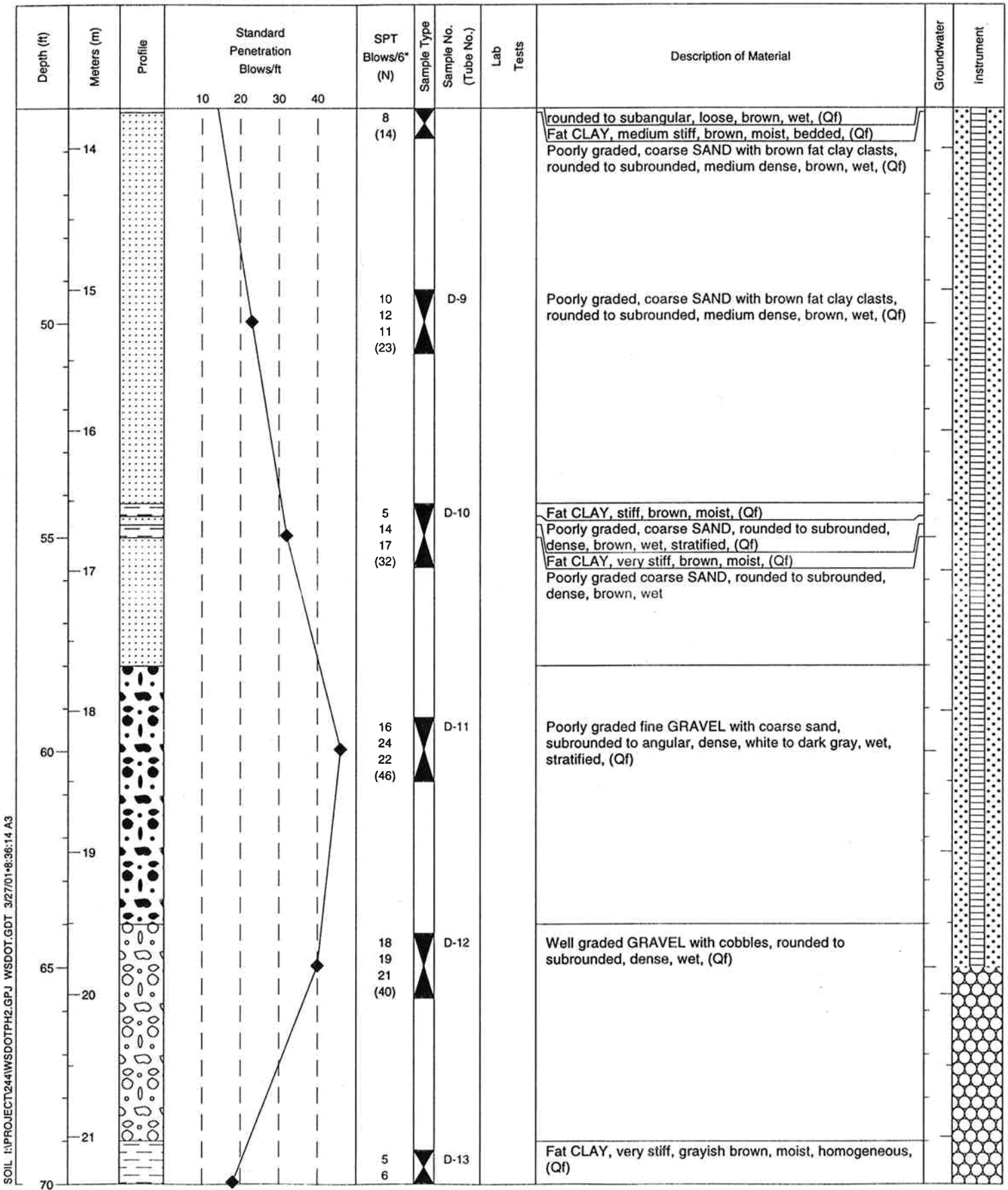

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Figure A-13 Page (3 of 5)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **WAND-2-00**

Sheet **4** of **5**

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

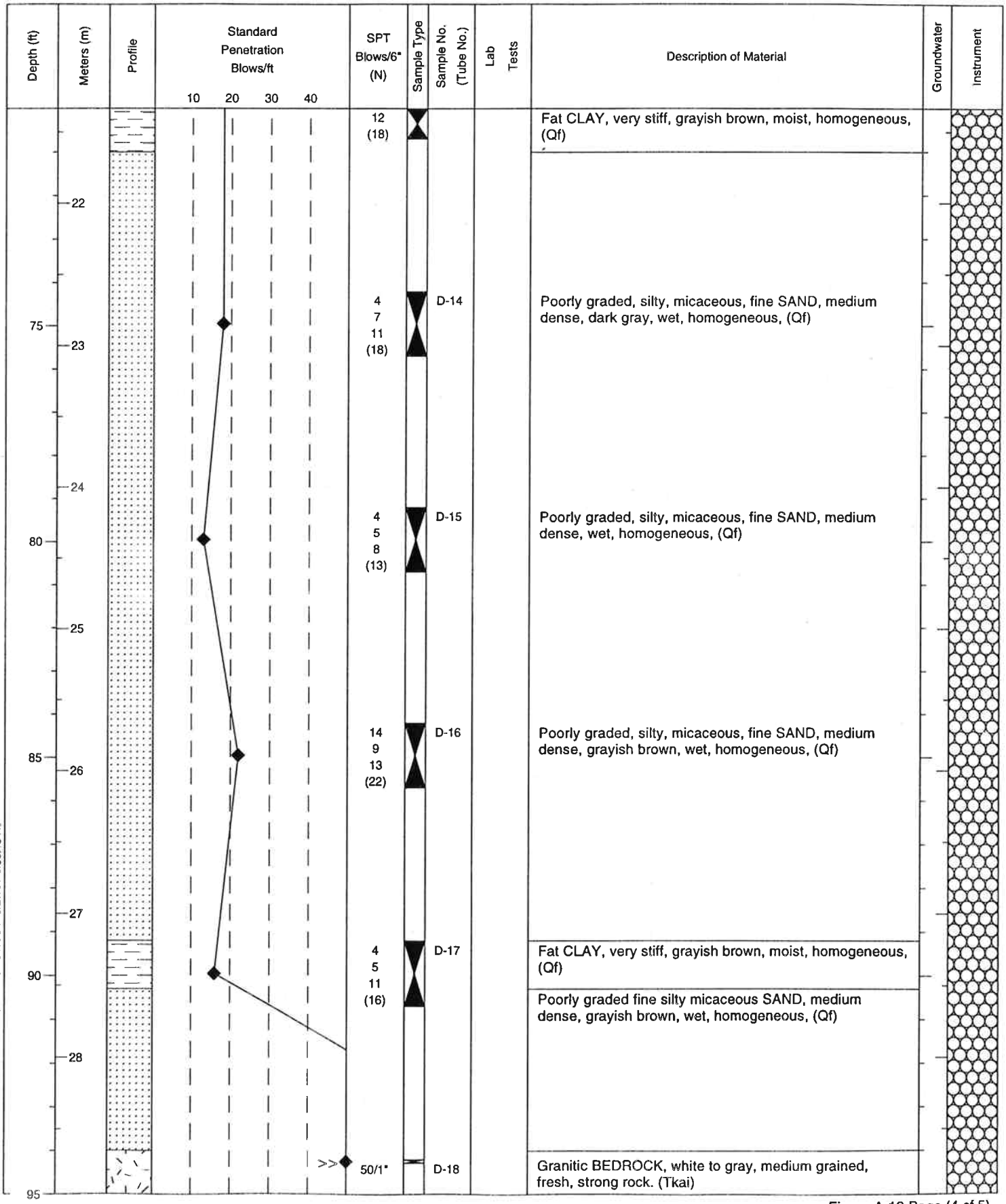

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Figure A-13 Page (4 of 5)

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **WAND-2-00**

Sheet 5 of 5

PROJECT **SR395 North Spokane Corridor Project**

Job No. **XL1154**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	29							Note: description based on observation of drilling rat, return fluid, and drill cuttings.		
	30							Note: Boring was advanced from 94.2 to 99.2 ft with HWT drilling		
100	31									
105	32									
	33									
110	34									
115	35									
	36									
120										

SOIL I:\PROJECT\244\WSDOTPH2.GPJ WSDOT.GDT 3/27/01 8:36:16 A3

Figure A-13 Page (5 of 5)

APPENDIX B

Laboratory Testing

APPENDIX B
LABORATORY TESTING

Natural moisture content, sieve analyses, and Atterberg Limit determinations were conducted by Soil Technology of Bainbridge Island, Washington (under subcontract to Landau Associates) on representative samples recovered from the borings for the purpose of classification and evaluation of pertinent engineering properties of soil types encountered. Laboratory testing was performed in general accordance with the American Society of Testing and Materials (ASTM) standard test procedures, which are described below. The samples were checked against the field log descriptions, which were updated where appropriate in general accordance with *WSDOT Soil and Rock Classification Guidelines*.

Natural Moisture Content

Natural moisture content determinations were performed on soil samples recovered from the borings in general accordance with ASTM D2216. The results are presented in Table B-1 in this appendix and on the boring logs in the column labeled "Lab Tests."

Grain Size Analyses

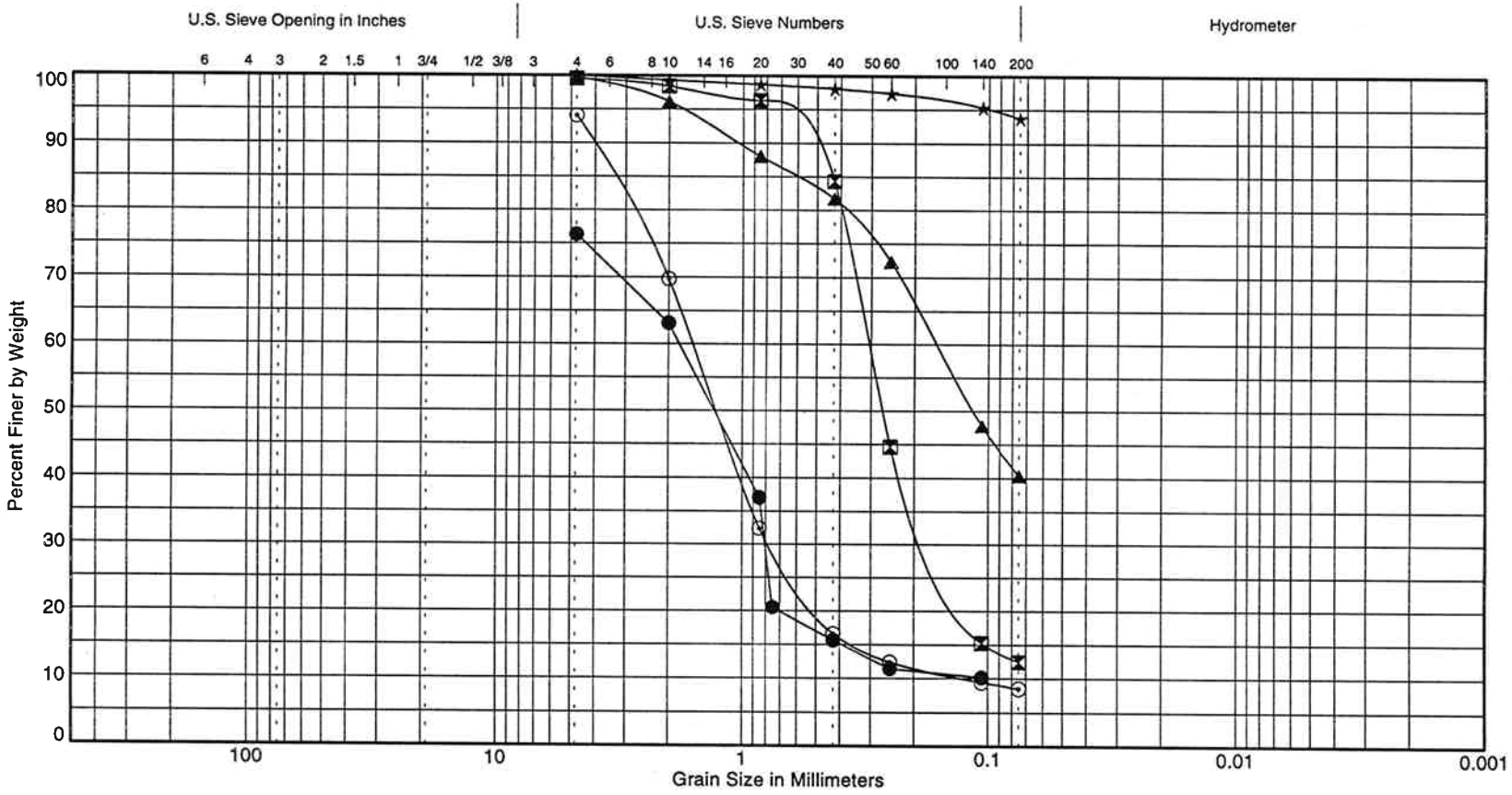
Grain size analyses were performed on representative soil samples obtained from the borings in accordance with ASTM D422 to provide an indication of their grain size distribution. The results of the sieve analyses are presented on Figures B-1 through B-5 in this appendix. Samples on which sieve analyses were completed are designated with a "GS" in the column labeled "Lab Tests" on the summary logs.

Atterberg Limit Determinations

Atterberg Limit determinations were performed on representative soil samples obtained from the borings in general accordance with ASTM D4318 to determine the liquid limit (LL), plastic limit (PL), and plasticity index (PI). The results of the Atterberg Limit determinations are presented on Figure B-6 in this appendix. Samples on which Atterberg Limit determinations were completed are designated by "AL" in the column labeled "Lab Tests" on the summary logs.

TABLE B-1
MOISTURE CONTENT DATA

Exploration No.	Sample No.	Sample Depth (ft)	Moisture Content (%)
PH2-1-00	D-2	10	1
PH2-1-00	D-4	20	3
PH2-1-00	D-6	30	11
PH2-1-00	D-8	40	17
PH2-1-00	D-10	50	16
PH2-3-00	D-1	5	1
PH2-3-00	D-6	30	23
PH2-4-00	D-1	5	23
PH2-4-00	D-3	17	18
PH2-5-00	D-1	5	16
PH2-5-00	D-3	15	3
PH2-5-00	D-10	49.8	34
PH2-6-00	D-3	15	13
PH2-6-00	D-6	30	10
PH2-7-00	D-3	15	14
PH2-7-00	D-6	20	12
PRY-1-00	D-2	9.5	10
PRY-1-00	D-5	24.5	21
PRY-1-00	D-7	34.5	15
DP-6-00	D-1	5	1
DP-6-00	D-2	10	3
DP-6-00	D-3	15	3
DP-6-00	D-5	25	40
SSSB-1-00	D-2	10	1
SSSB-2-00	D-1	5	6
SSSB-2-00	D-5	25	3
SSSB-2-00	D-8	40	38



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

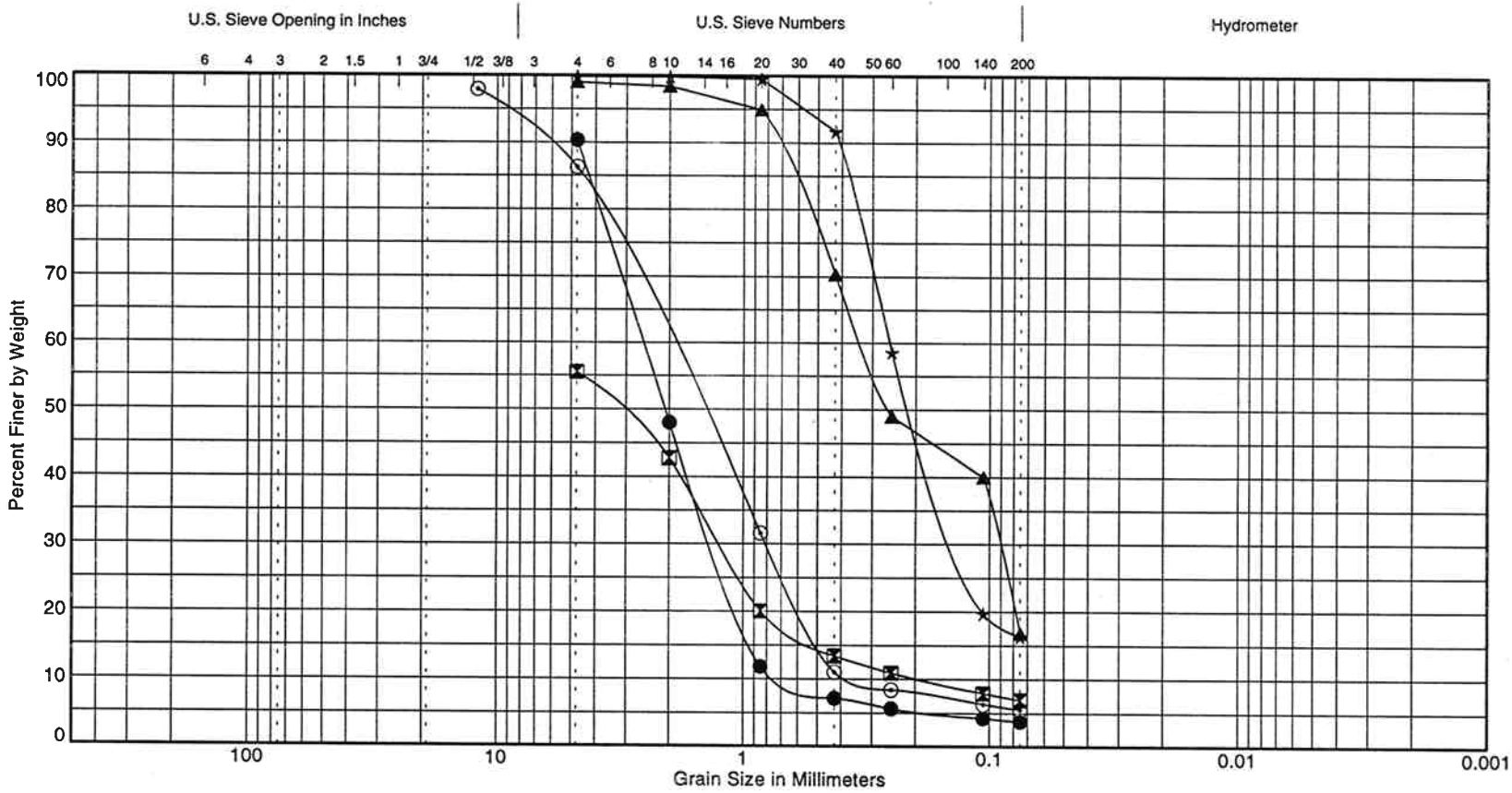
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	PH2-1-00	D-2	10.0	1	Silty SAND with gravel	SM
⊠	PH2-1-00	D-4	20.0	33	Silty SAND	SM
▲	PH2-1-00	D-6	30.0	11	Silty SAND	SM
★	PH2-1-00	D-10	50.0	16	Lean CLAY	CL
⊙	SSSB-1-00	D-2	10.0	1	Well graded SAND	SW

Landau Associates

SR395 North Spokane Corridor Project
Spokane, Washington

Grain Size Distribution

Figure B-1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

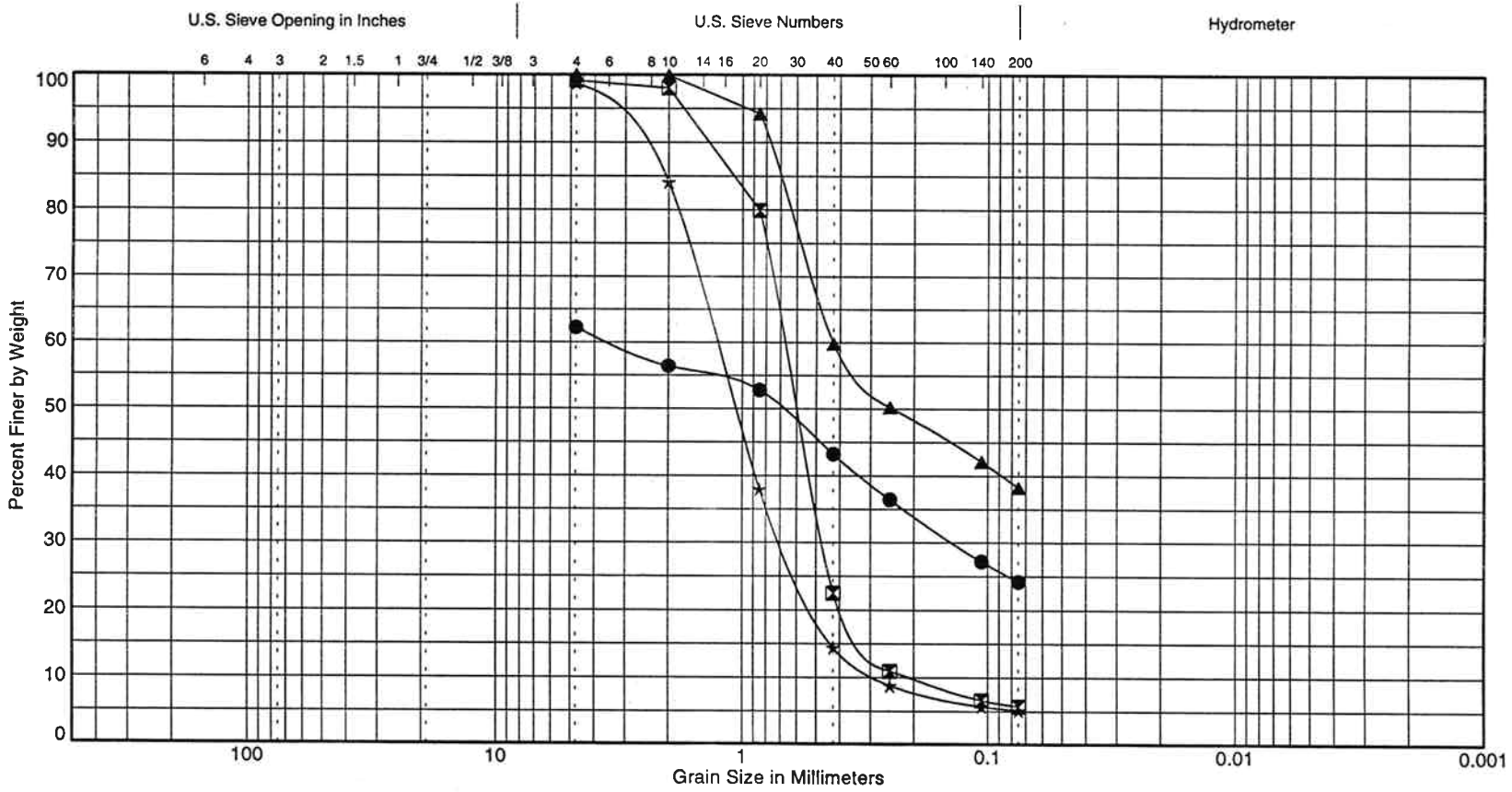
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	DP-6-00	D-1	5.0	1	Poorly graded SAND	SP
⊠	DP-6-00	D-2	10.0	3	Poorly graded SAND with gravel	SP
▲	DP-6-00	D-3	15.0	3	Silty SAND	SM
★	SSSB-2-00	D-1	5.0	6	Silty SAND	SM
⊙	SSSB-2-00	D-5	25.0	3	Poorly graded SAND	SP

Landau Associates

SR395 North Spokane Corridor Project
Spokane, Washington

Grain Size Distribution

Figure B-2



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

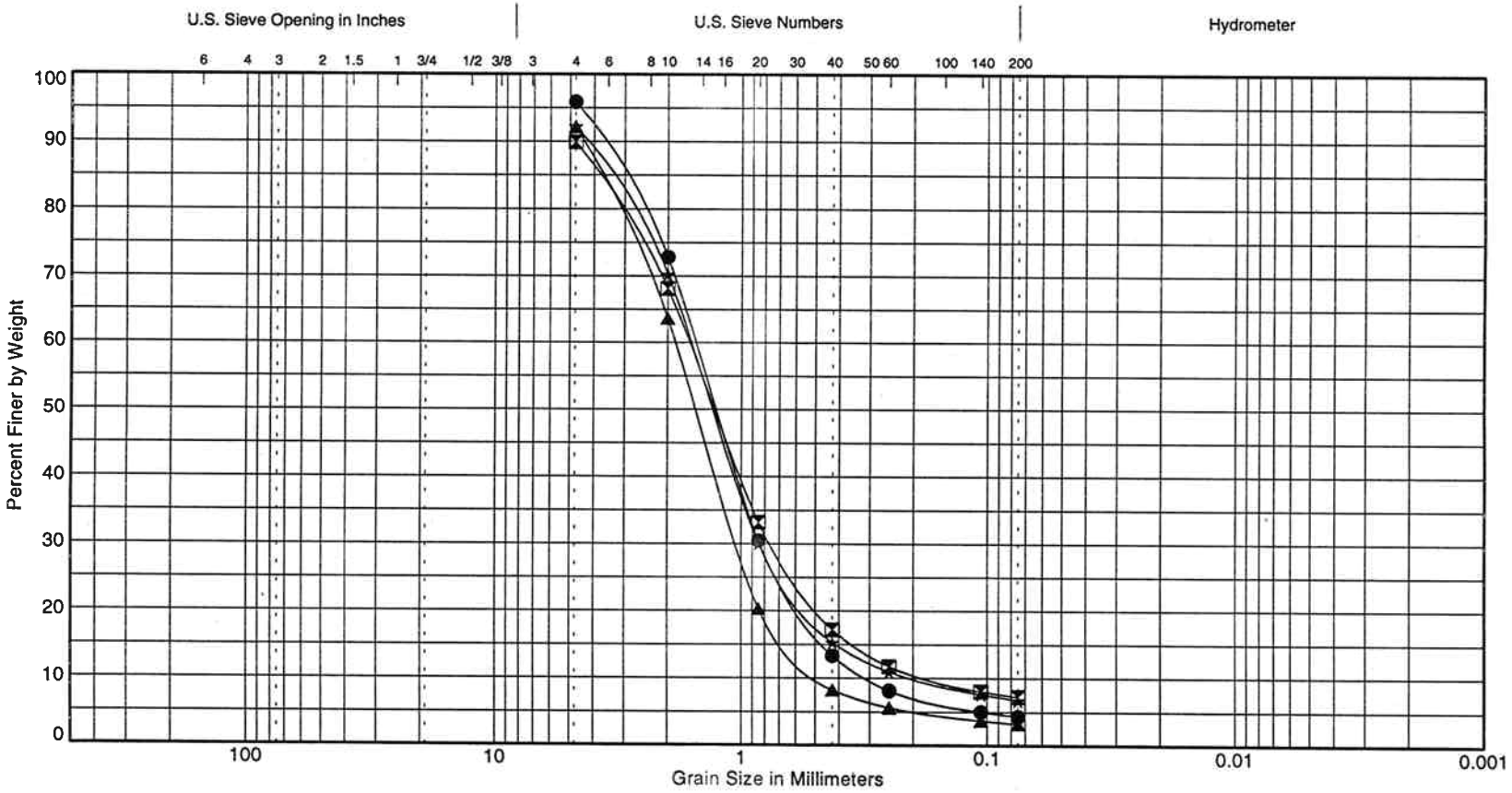
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	PH2-3-00	D-6	30.0	23	Silty SAND with gravel	SM
⊠	PH2-4-00	D-3	17.0	17	Poorly graded SAND	SP
▲	PH2-5-00	D-1	5.0	16	Silty SAND	SM
★	PH2-5-00	D-3	15.0	3	Poorly graded SAND	SP

Landau Associates

SR395 North Spokane Corridor Project
Spokane, Washington

Grain Size Distribution

Figure B-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

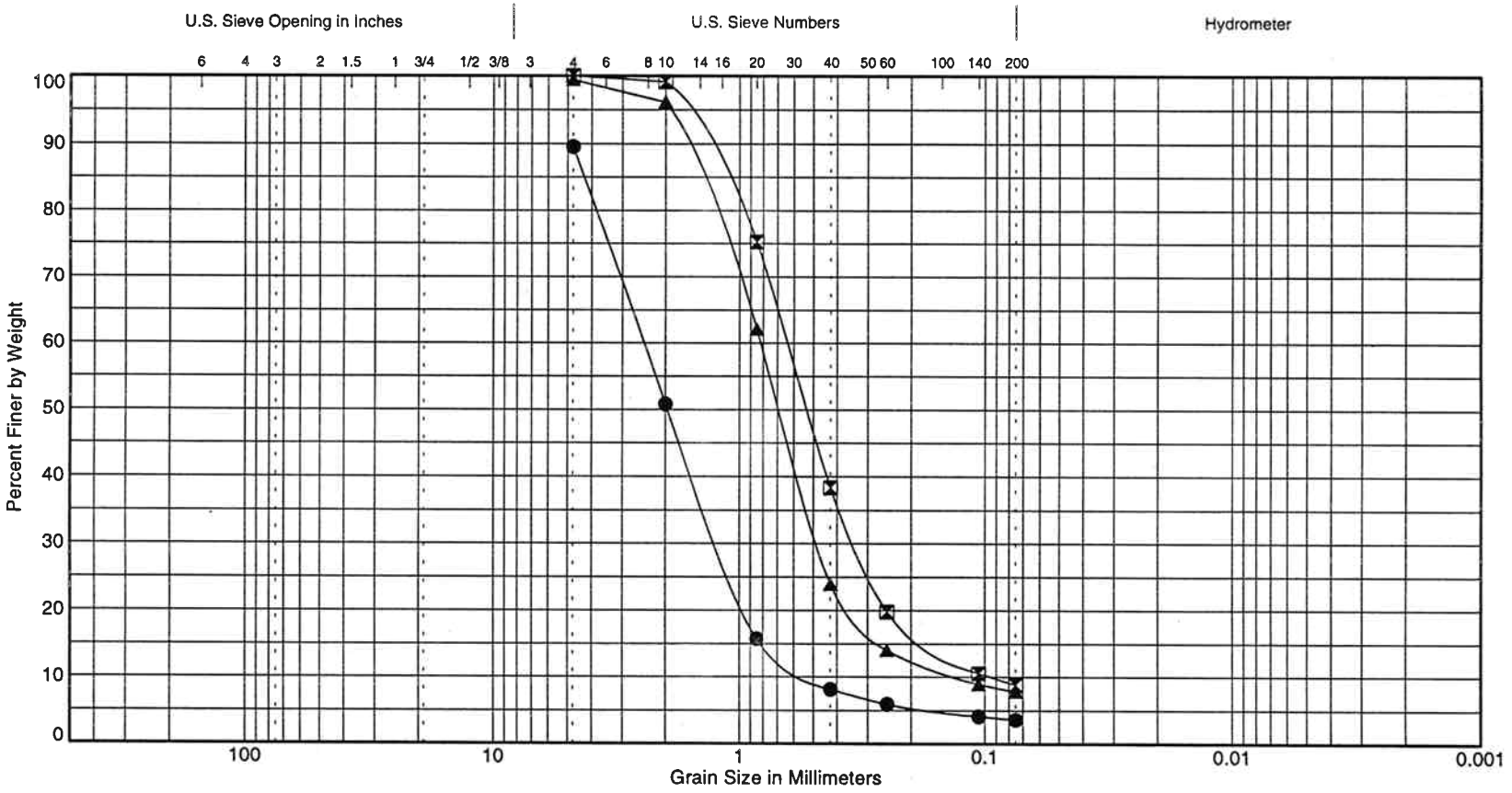
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	PH2-6-00	D-3	15.0	13	Poorly graded SAND	SP
⊠	PH2-6-00	D-6	30.0	10	Well graded SAND	SW
▲	PH2-7-00	D-3	15.0	14	Poorly graded SAND	SP
★	PH2-7-00	D-6	30.0	12	Well graded SAND	SW

Landau Associates

SR395 North Spokane Corridor Project
Spokane, Washington

Grain Size Distribution

Figure B-4



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

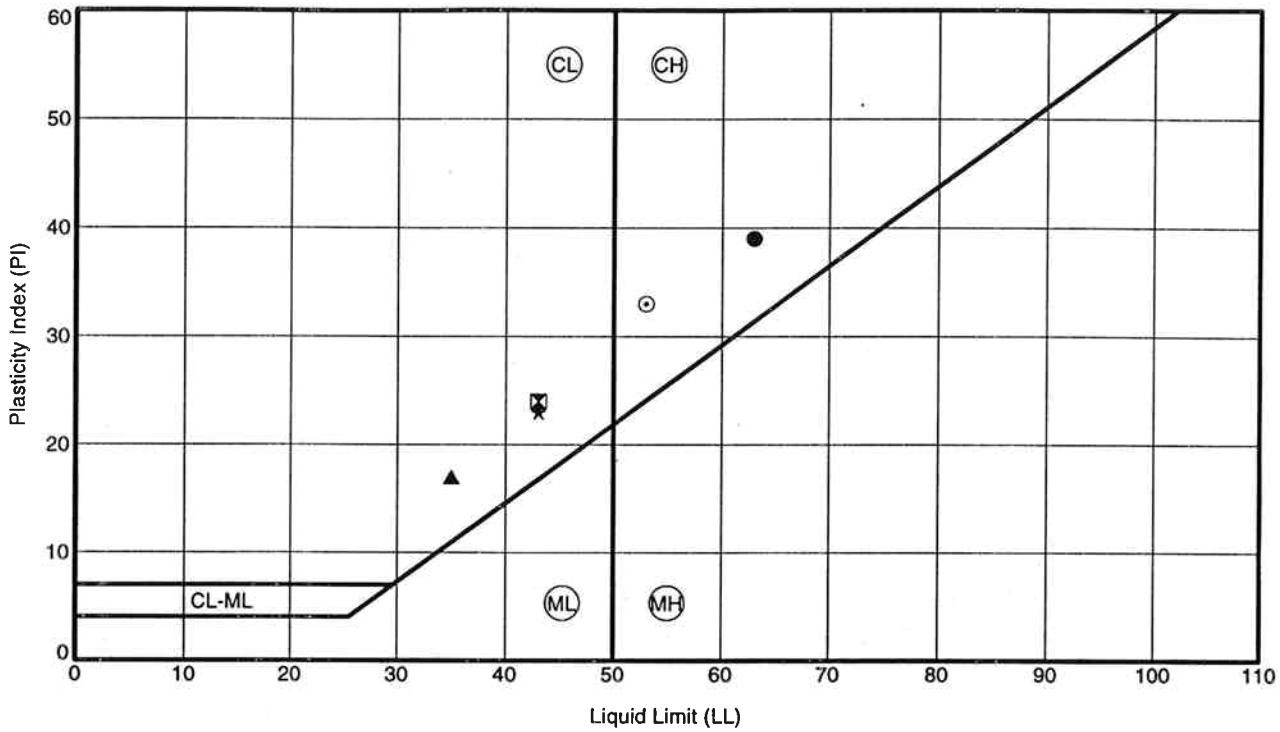
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	PRY-1-00	D-2	9.5	10	Poorly graded SAND	SP
⊠	PRY-1-00	D-5	24.5	21	Well graded SAND	SW
▲	PRY-1-00	D-7	34.5	15	Poorly graded SAND	SP

Landau Associates

SR395 North Spokane Corridor Project
Spokane, Washington

Grain Size Distribution

Figure B-5



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	DP-6-00	D-5	25.0	63	24	39	40	Fat CLAY	CH
⊠	PH2-1-00	D-8	40.0	43	19	24	17	Lean CLAY	CL
▲	PH2-1-00	D-10	50.0	35	18	17	16	Lean CLAY	CL
★	PH2-5-00	D-10	49.8	43	20	23	34	Lean CLAY	CL
⊙	SSSB-2-00	D-8	40.0	53	20	33	38	Fat CLAY	CH

ASTM D 4318 Test Method

ATTERBERG LIMITS FIGURE I:\PROJECT\244\WSDOT\PH2.GPJ WSDOT.GDT 3/19/01 4:10:17 P3

Landau Associates

SR395 North Spokane Corridor Project
Spokane, Washington

Plasticity Chart

Figure B-6